BOTANICAL SUMMARY OF A LOWLAND ULTRABASIC FLORA IN PAPUA NEW GUINEA

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ABSTRACT

The ultrabasic flora of the Kamiali Wildlife Management Area is described from a recent series of floristic surveys. The general account and checklist also incorporates information from earlier collections. Two new species are presented: *Psychotria bulilimontis* (Rubiaceae), and *Trichadenia sasae* (Salicaceae). Other taxa of special interest are briefly discussed.

Key Words: botanical survey, serpentine, ultrabasics

JAPANESE ABSTRACT

カミアリ野生生物管理区の超塩基性植物相について、最近行われた一連の植物調査の結果から記述する。初期に行われたパプア超塩基性ベルト地帯での採集調査結果もモロベ州南部の低地蛇紋岩地域の調査結果と共に総合的に扱った。2つの新種、*Psychotria bulilimontis*(アカネ科)と*Trichadenia sasae*(イイギリ科)について発表するとともに、特に興味深い他の分類群についても簡単に記す。

キーワード：植生調査、蛇紋岩、超塩基性土壌

INTRODUCTION

After more than a century of scientific publication on the Papuasian flora, the ultrabasic (i.e. ultramafic or serpentine) vegetation of Papua New Guinea (PNG) is still largely unknown in spite of its unusual qualities. Multidisciplinary surveys were initiated in 1997 to address the need for information from such areas, using the Kamiali Wildlife Management Area (KWMA) as a focal site for biodiversity assessment (Figs. 1–2). The selected location offered a number of unique advantages among comparable PNG environments, as it included a complete elevational sequence of natural-growth habitats from sealevel to cloudy summits, and its exploration could be conducted with cost-effective itineraries. In the following narrative, botanical results from the recent investigations are presented and integrated with earlier work in the Papuan Ultrabasic Belt.

HISTORICAL BACKGROUND

The first collections from southern Morobe were made in the Waria drainage (Fig. 3) by R. Schlechter (in 1908; see Schlechter 1911–14) after which there was a general neglect of the district until the NGF/LAE collections of the former Department of Forests. Most of Schlechter's specimens were later lost during the WWII destruction of the Berlin Herbarium. In 1990, Clements rediscovered

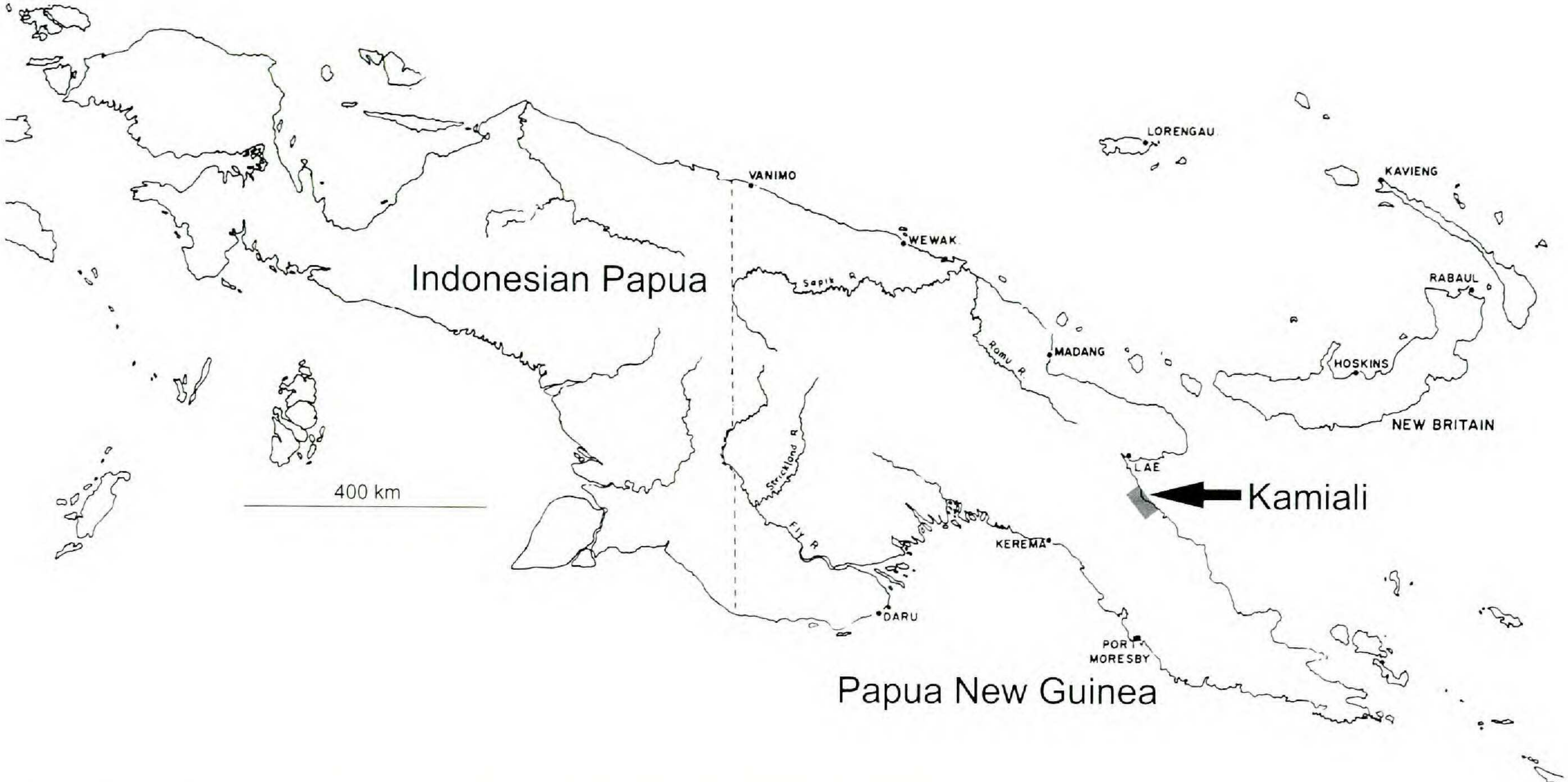

FIG. 1. Island of New Guinea. Shaded area: lowland interval of the Papuan Ultrabasic Belt. Arrow: Kamiali village.

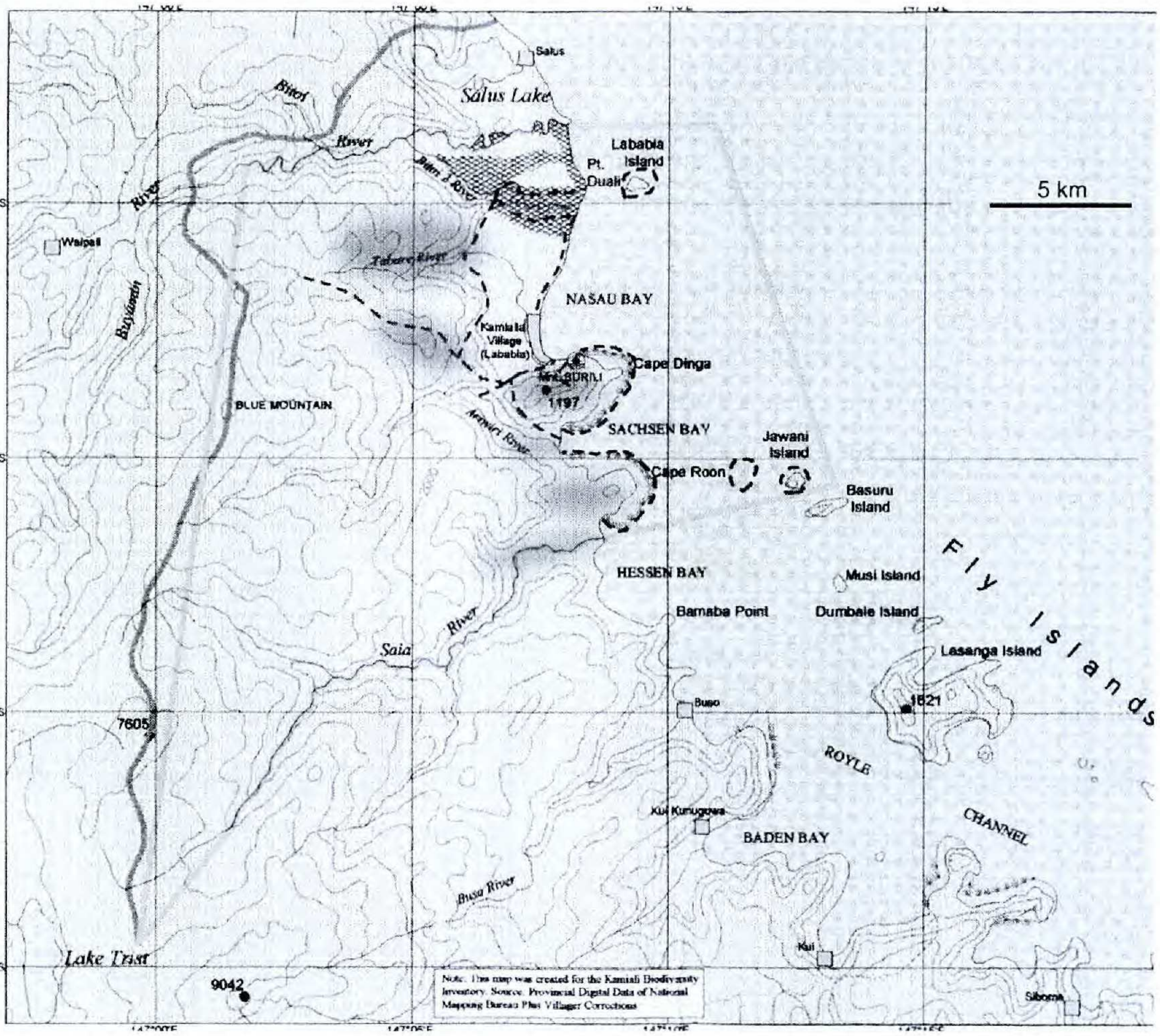

FIG. 2. Kamiali Wildlife Management Area (KWMA). Light-colored perimeter: KWMA gazetted boundary. Darker-colored perimeter: customary lands claimed by the Kamiali people. Shaded elliptical areas: principal survey sites. Contours: 250′, 500′, 1000′, then subsequently in increments of 1000′. Adapted from Village Development Trust file map.

several of the lost German taxa and described some new ones (Clements & Ziesing 1990). Exploration of nearby Natter Bay (e.g. by Croft in 1976) also yielded interesting new material (Fig. 4). Since 1908 there has otherwise been little collections activity between the Waria River and Paiewa (Paiawa).

Particularly during the 1970s, the area around Buso was used as a training site by the Bulolo Forestry College (now Bulolo University) and many specimens were taken during periodic visits by expatriate botanists of that general period (*inter alia* B. Conn, D. Foreman, A. Gillison, E. Henty, M. Jacobs, A. Millar, C. Ridsdale, and H. Streimann). Although the Buso locality is thus relatively well documented in comparison to adjacent areas, it was later despoiled by logging subsidiaries of Rimbunan Hijau. Confronted by mounting environmental concerns from landowners and advocacy groups, the last logging company (Timber Products Marketing Corporation) was forced to leave in 1995, but by

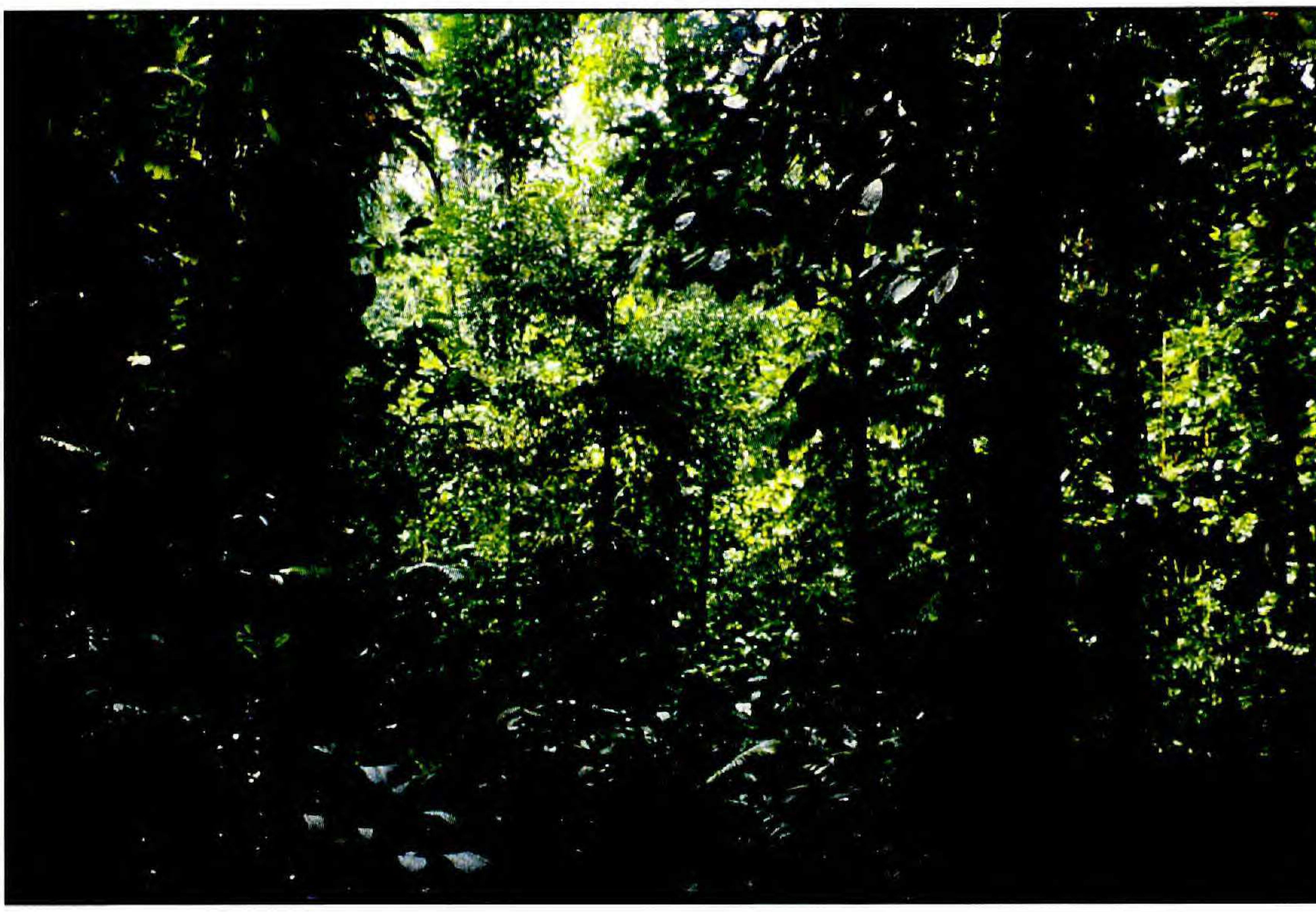

FIG. 3. A typical non-ultrabasic forest in the alluvial zone of the Waria River.

FIG. 4. Natter Bay. Coastal ridges dominated by remnant stands of *Anisoptera thurifera* ssp. *polyandra*.

then an extensive territory between Buso and Morobe Bay had been harvested by commercial operators (Fig. 5).[1] Athough remnant *Anisoptera*-dominant stands are still scattered along the S Morobe coast (e.g. at Siboma or 'Simpoma'), most of the low elevation forests are currently in early successional recovery. The Kamiali Wildlife Management Area (KWMA) is now the only significant primary-growth habitat in the Huon electorate southeast of Lae.

In 1992–1993, the villages of SE Morobe (i.e. Kamiali, Buso, Kui, Siboma, and Paiewa) developed a cooperative proposal for environment-sensitive alternatives to the concessional logging which was then occurring (Zibe-Kokino 1993). Known as the Lasanga Island-Lake Trist Conservation Project, the initiative was based on the principles of Integrated Conservation and Development (ICAD), an economic model which promotes smallscale enterprise as a substitute for ecologically-disruptive activities.

Since its early beginnings at Crater Mt, the ICAD methodology has developed into the principal present-day mechanism for environmental conservation in PNG, as evidenced by the growing body of literature produced by its proponents (e.g. James 1996; Johnson 1997; McCallum & Sekhran 1997; Pearl 1994; Saulei & Ellis 1998; Wagner 2001a, in press). Several major programs are currently being implemented under the ICAD format, most notably by testbed projects in the Adelbert Mts, Crater Mt, Hunstein, Kamiali, Kikori, Milne Bay, and Tonda. However, some conspicuous failures have occurred (McCallum & Sekhran 1997).

Many issues and problems encountered at other ICAD localities were also experienced by the Lasanga-Lake Trist initiative, in particular the inability of stakeholders to achieve a consensus as each clan group fought to maximize its own benefits. After the original design for a 250,000 ha easement was compromised by funding difficulties, the proposal was recast as a 47,000 ha conservation area including only the Kamiali territory (Anon. Sept. 19, 1996). This reduction in scope enabled the project to proceed by focusing participation on a more homogeneous combination of landowners, but at a probable loss in protection of biodiversity values.

The present KWMA is a linked land-sea conservation zone, of which only 29,285 ha is terrestrial environment (ibid.). While there is little consensus on the minimum size requirement for protected areas, it is unlikely that the existing KWMA is large enough to serve as a stand-alone conservation unit. The self-sustainability of biotic communities arguably requires significantly larger territories, especially in view of the destructive effects of probable disturbance

[1]Additional timber production blocks were subsequently proposed by the National Forest Plan (Anon. 1996) for Salamaua, Lake Trist, and Waria Valley. Placed in abeyance by a country-wide forestry moratorium, the prohibitions against new logging projects were recently lifted. However as a result of the logging damage from previous years, it will be difficult for industrial operators to reenter the general area, in part because of the environmental advocacy now conducted by organizations such as VDT.

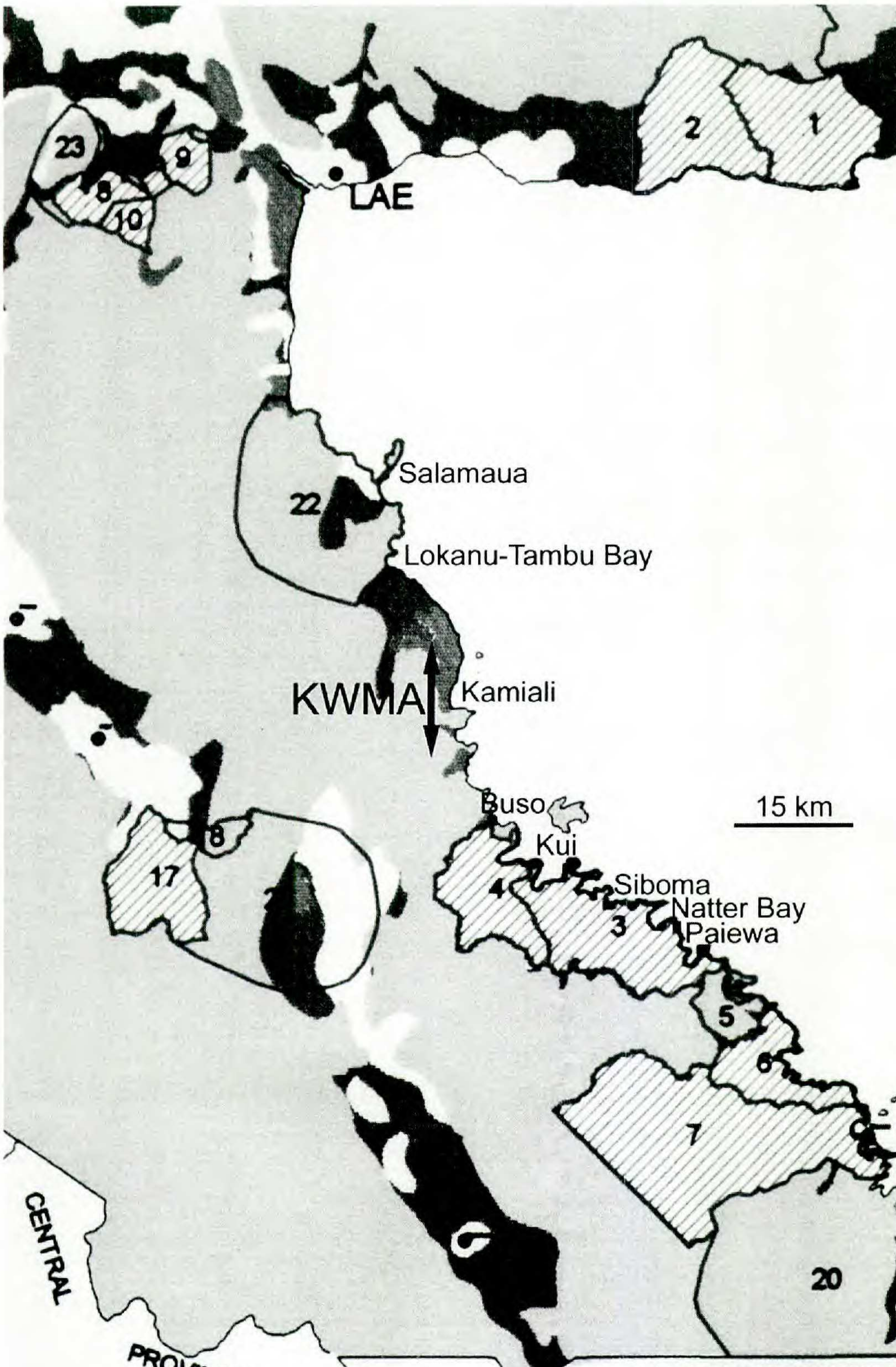

FIG. 5. Forest production areas in south Morobe (striped blocks 3–7). 3. Kui Buso TP (Timber Purchase); 4. Kui Buso extension TP; 5. Maiama-A TP; 6. Maiama-B TP; 7. Morobe TP. Other localities from the text are also indicated. The Waria River (not shown) is near the boundary between Morobe and Northern Provinces. Adapted from Anonymous (1996).

mechanisms such as cyclonic storms and El Niño events. In depauperate forests with monodominant canopies (e.g. Hawaii), a complete suite of species and forest successional stages can be encompassed by tracts as small as 100–200 ha (Mueller-Dombois 1980). But New Guinea floristic environments are among the richest in the paleotropics, and the minimum-area requirements are several orders of magnitude higher. Jeffries (1996) for example, gives 50,000 ha as a lower limit for biodiversity protection, while Beehler and Alcorn (1993) go as high as 800,000 ha. Even within that wide interval, the existing Kamiali easement falls substantially under target. Against this background, the impending expansion of the KWMA to a southern boundary near Paiewa will help to address some of the biological requirements implicit in ICAD design. Sanctioned by local communities in 2002, the new development will bring ca. 300,000 ha of terrestrial environment under conservation management (Kisokau & Siga, pers. comm. Feb. 2003).

Although traditional cultures in PNG are often depicted as being based on consultation and consensus, achieving a determination of common purpose or directed action is never easy. Centrifugal forces are powerful in local politics, as clan, subclan, and kinship self-interests are more important than any perception of the common good (Martin 1998). Expansion of ICAD operations from Kamiali into adjacent territories is certain to aggravate the difficulties inherent in management of customary lands. Those same problems previously led to the polarization of the original Lasanga-Lake Trist conservation plan. The successful resolution of conflicts arising from parochial motivations will determine the effectiveness of the enlarged VDT conservation area at Kui-Siboma and of possible future expansion along the coastal corridor to Oro (Northern) Province. Whether this can actually be achieved within the context of the ICAD philosophy is very much an ongoing issue of considerable future significance to conservation in PNG.

The Physical Environment

Climate.—The KWMA lies mostly within Morobe's lowland and premontane climatic zones, where the mean annual rainfall is 3,000–4,000 mm. The wettest months generally occur during January–April, when prevailing winds are northwesterly, and the driest in May–August when the winds are replaced by southeasterly trades (McAlpine et al. 1983). Even during the dry season, mean monthly rainfalls are generally around 200 mm, and the vegetation is rarely subjected to water shortages under normal circumstances (ibid.: 140). Most climatic classifications would describe the project sites as tropical everwet or perhumid, reflecting the overall absence of moisture deficits.

In the western Pacific, El Niño oscillations are typically accompanied by severe droughts in rainforest environments like the Bowutu Range. During the 1997–98 disturbance, coastal tracts adjacent to the KWMA were subjected to

devastating fires which destroyed substantial areas of forest (Fig. 6). Formerly covered with primary growth, Lasanga burned out of control during the 1997–98 drought and is now a weedy island. In marked contrast to the El Niño episodes, the periods of peak rainfall are often accompanied by severe flooding in the lowlands and numerous landslides on higher slopes. In 1999 the La Niña rains resulted in torrential surges along the main rivers emptying into Nasau and Sachsen Bays, completely destroying the subsistence gardens on the Bitoi Delta. As the KWMA rivers overflowed their banks, the flood waters flattened wide channels through the surrounding alluvial forest. The botanical team subsequently enjoyed unprecedented access and easy collecting along the corridors of felled canopy, which years later, are now becoming clogged with impenetrable thickets of *Calamus*.

Geology.—Much of New Guinea's diversity has been shaped by a complex and dynamic geological past. Although the southern part of the island is an extension of the Australian craton, the northern districts are a melange of former island arcs which rafted onto the mainland during the northward migration of the Australian landmass (Dow 1977; Jaques & Robinson 1975; Pigram & Davies 1987). The Papuan Peninsula, consisting of the SE-trending 'tail' of New Guinea, represents the remnants of an accreted arc (Hamilton 1979).

The Bowutu Range forms a major portion of the Papuan Peninsula and is also PNG's most extensive elevational series of ultramafic landscapes (Dow & Davies 1964). This general region is part of a terrane complex paleohistorically distinct from the rest of northern New Guinea, having docked with the mainland ca. 10 m.y. after the Sepik terranes (Pigram & Davies 1987). The area's unusual geology has led to its recognition as a separate physiographic province, extending from the Kamiali coastline to the craggy summits of the Owen Stanley Range (i.e. the Papuan Ultrabasic Belt, cf. Bain 1973; Löffler 1977; Thompson & Fisher 1965). Between Lokanu-Tambu Bay and Kui village, the ultrabasic belt forms a continuous series of lowland environments. The offshore islands such as Lasanga and Musik are part of a different (nonserpentine) geological series reaching southwards to the Waria River (Dow & Davies 1964) and are excluded from consideration in this paper.

Soils.—Ultrabasic environments are characterized by substrates low in silica, but with high magnesium and iron contents. In addition to deleterious magnesium/calcium ratios, ultrabasic soils are frequently associated with phytotoxic concentrations of nickel, chromium, and cobalt (Brooks 1987; Whitmore 1975). The influence of heavy metals is often cited as being responsible for the stunted vegetation of serpentine habitats, though it should be noted that low-statured canopies are not an invariable feature of ultramafic forests (see Fox & Tan 1971; Proctor et al. 1988).

Bowutu populations from at least one species [*Rinorea bengalensis* (Wall.)

FIG. 6. Bulili Ridge. Forest burn from the 1997–98 El Niño drought.

O.K.], are known to accumulate nickel (Brooks 1987). There are no reports of heavy metal accumulation in other native plants. A brief discussion of serpentine floras in New Guinea is provided by Brooks (ibid.), Paijmans (1976), and van Royen (1963), but there is a conspicuous absence of floristic data in such accounts. A summary of ultrabasic vegetation is otherwise available for the tropical far east (Proctor 1992). While it is generally recognized that ultrabasics are associated with depauperate canopies easily discerned in aerial photographs (Paijmans 1976), the species composition of the communities remains poorly known for Papuasia. Comparative studies from Western Malesia show wide variation in the structure and endemism of such floras (Proctor et al. 2000).

Ultrabasic terrain in PNG is characteristically composed of massive ridges with uniform slopes and unstable soils (Löffler 1977; Paijmans 1976). The topographic instability of the study area is reflected in the presence of old landslip scars on many mountainsides (Figs. 7–8). Earthquakes with shallow epicenters are common in northern New Guinea (Hamilton 1979), and can aggravate local tendencies for landsliding. Quake-triggered landslides have been responsible for many fatalities in Morobe Province.

The KWMA hill habitat is unsuitable for agriculture (Bleeker 1975a, 1975b) because of erosion hazards and the general infertility associated with serpen-

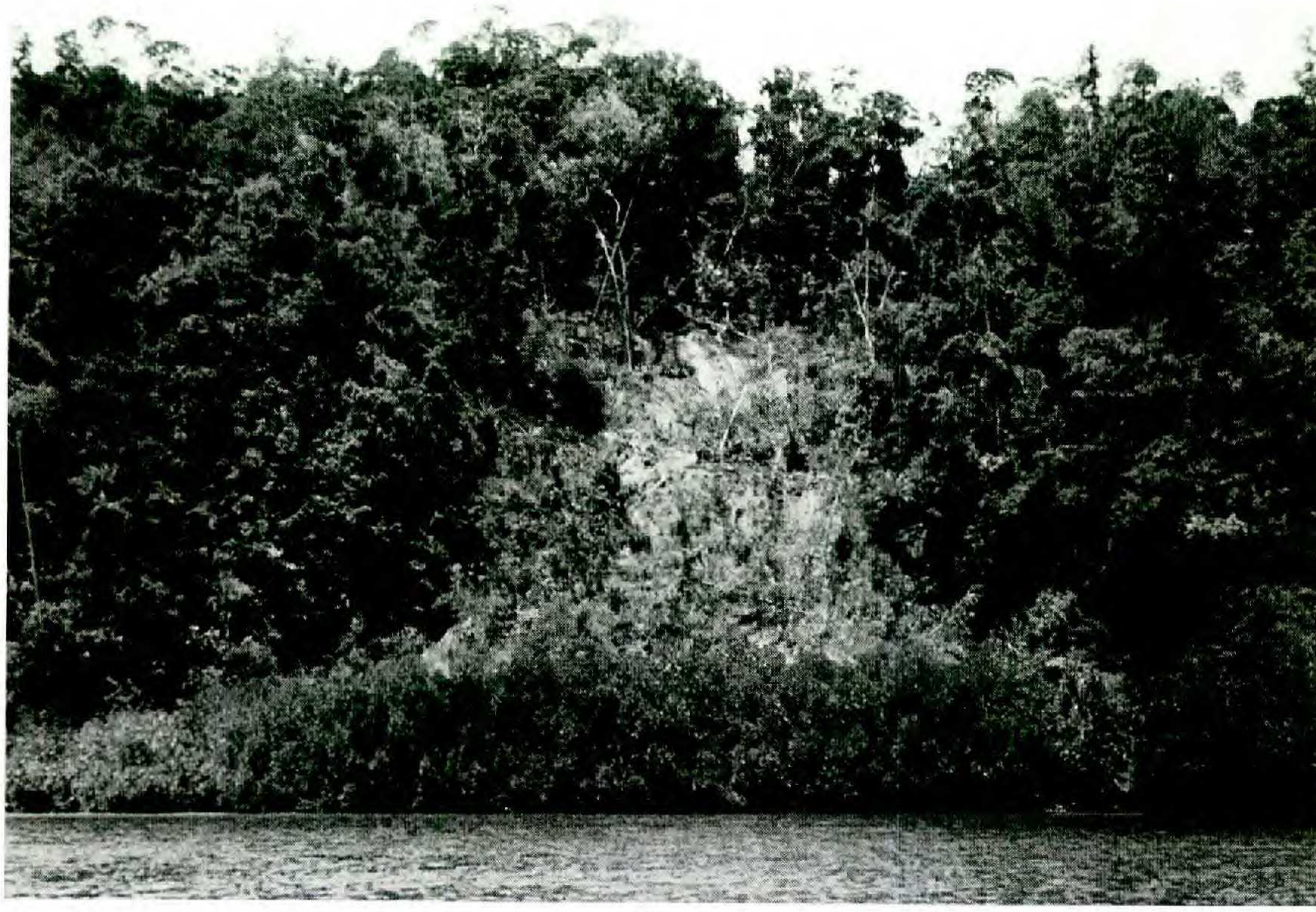

Fig. 7. Sachsen Bay. Landslide behind mangrove community.

tine substrates. In contrast, the flood plain of the major streams (Bitoi, Tabali, Arawiri, and Saia),[2] have deep deposits of organic alluvium (Fig. 9). The Bitoi Delta between the Areta (N) and Daunawa (S) branches is a particularly fertile tract in which nearly all the Kamiali food gardens are concentrated. Unlike many Highlands areas where intensified cropping has led to lowered productivities (see Levett & Bala 1995), the KWMA agricultural system has surplus capacity capable of supporting twice the present population (Bein et al. in press, in submission). The high productivities are due to the presence of rich delta soils and their renewal by seasonal floods (ibid.).[3] These factors have enabled the adoption of a shortened 7-year garden cycle (vs. an estimated 20 years in normal slash and burn rotations). At current rates of population increase, the existing subsistence system can probably satisfy local needs for 35 more years without any expansion in area (Wagner 2001b).

The Social Environment

The total population of Kamiali was 520 in August 1997. There are two major

[2]On contemporary maps the Arawiri (Ariwiri) is shown as the Alealer River, and the Saia as the Sela River (Royal Australian Survey Corps Series T601, Nasau sheet 8383, Edition 1-AAS, 1:100,000).

[3]Martin (1998) specifies a Bitoi crop rotation of 3–4 years and suggests the standard rotation period at nearby Kui village is 10–15 years. Levett and Bala (1995) give 7–20 years as the standard swidden cycle for PNG.

FIG. 8. As for figure 7, showing the successional community. The seral taxa include mainly *Dicranopteris linearis*, *Machaerina glomerata*, *M. rubiginosa*, *Myrtella beccarii*, and *Stenocarpus moorei*.

Fig. 9. Saia River. Several new fish species have been discovered in the clear-flowing streams of the KWMA.

clans, the Gara and Tabali, and at least 12 subclans (Martin 1998, 1999). Kela is the indigenous tongue, one of approximately 200 comprising the Austronesian language group of northeastern New Guinea (McElhanon 1984; Wurm 1985). Nearly all villagers also speak the lingua franca of PNG (i.e. Tok Pisin). With the recent establishment of a community school, most children have acquired at least some understanding of English.[4]

Seemingly unstructured to western observers, local village life is actually governed by an extensive network of customary practices and expectations. Inheritance and property rights are matrilineal by tradition, but considerable change is occurring as a result of exposure to modern influences. Martin (1998, 1999, 2001) and Wagner (2001b) provide an informative discussion of social developments in their specific connection to conservation.

Despite their retention of customary lifestyles, Kamiali inhabitants are surprisingly sophisticated and informed, a direct result of the quality-of-life improvements introduced by the Village Development Trust within the past 10 years. Several community leaders for example, are computer literate and maintain international email contacts from VDT's offices in Lae. As another sign of

[4]There are 6 principal Kela-speaking villages on the Huon coast, divided into two apparent dialect groups. Kamiali has its closest linguistic and kinship affinities to the hamlets of Buso and Kui immediately to the southeast, the latter centers having been established by migration of Kamiali settlers during a former time of epidemic (Martin 1998).

cultural change, researchers are required to establish a Memorandum of Understanding with village-appointed representatives, disclosing the purpose of an intended study and affirming its obligations to the Kamiali people.

The KWMA villagers are dependent on marine resources for their livelihood (mainly reef fishing) supplemented by a limited range of garden crops. Cash incomes are small and sporadic, on a household basis typically falling between PGK 500–4,000 per year (at current rates 1 PGK=0.25 USD), mostly from the sale of fish, sea shells, and betel nuts (Martin 1998; Wagner 2001b). Although the Kamiali territory consists predominantly of primary forest rich in animal life, only three individuals from the village population (Enok Nasa, Tani Jena, Tom Ziena) are known to actively hunt wild game such as cuscus, pigs, cassowaries, and wildfowl. For a people with copious forest resources, remarkably little use is made of the terrestrial environment. Even among the small hunting fraternity, forest forays are apparently undertaken mainly for recreation, and overnight trips are rarely attempted. To a certain extent, the apparent avoidence of inland habitats may be due to a belief in animalism and spirits (masalai), even though all villagers profess devotion to the Christian (Lutheran) faith. For whatever reason, there is essentially no human presence in the interior areas above 500 m. Since subsistence farming is confined to the flood plain on the Bitoi Delta (a tract of ca. 460 hectares), human impacts on the environment are practically nonexistent (Martin 1998; Wagner 2001b).

The Logistical Environment

In geographic regions with the environmental qualities of New Guinea, investigators have little difficulty identifying biologically suitable localities for botanical research. During the selection of potential study sites, the logistical limitations imposed by poor civil infrastructures often take precedence over the biological concerns. When viewed in this context, the KWMA offers a particularly attractive combination of site attributes.

In addition to exceptional floristic quality, the coastal location of the KWMA and its proximity to Lae (the second largest city in the country) provide researchers with unusually cost-effective logistics. There is no other conservation locality in PNG offering equivalent accessibility and scientific value in one package. While many natural areas are of similar interest, their remoteness and associated travel costs discourage longterm study. Although the KWMA has no roads or airstrips, the site can be conveniently reached by outboard-equipped dinghies ('speedboats').[5]

On the shores of Nasau Bay the Village Development Trust maintains a permanent training center, guest houses, on-site staff, wireless communications, and sea transport. Primary forest is immediately adjacent to the accommodations,

[5]Travel time is 2.5 hours from Lae by 40 hp outboard and 1.5 hours by 70 hp. Charter rates for 40 and 70 hp speedboats are PGK 600 and PGK 800 respectively (roundtrip Lae-Kamiali).

allowing easy access to serpentine vegetation. With electric generators for the facilities available on continuous standby, researchers are able to live and work under conditions conducive to high morale and productivity. Of particular importance to scientists using customary lands, access and intellectual property issues have been successfully negotiated via VDT-brokered agreements with local landowners. In recognition of these infrastructural advantages, the KWMA was selected as the principal PNG site for elevation-sequenced studies in the Pacific-Asia Biodiversity Transect network (PABITRA; Takeuchi 2003a, digital images on http://www.senckenberg.uni-frankfurt.de/odes/).

In conformity with the ICAD concept, ecotourism is actively encouraged as an environment-friendly enterprise within the conservation zone. Kamiali's scenic shoreline of white-sand beaches is currently a featured scientific attraction, with nearly 5 km of waterfront serving as active nesting sites for the endangered leatherback turtle. Substantial numbers of science-oriented visitors arrive during the haul-out season in November-March to observe the turtle tagging operations (Kisokau & Dutton 2002; Lindgren 1999a). In marked contrast to the spartan conditions at most research venues, the KWMA's ambience and infrastructure are comparable to a vacation resort.

Kamiali's checkered history forms a colorful backdrop to these present-day assets. During WWII Nasau Bay was the site of a major battle between Allied and Japanese forces (see Lindgren 1999b, 2000, for a popular account), and many war artefacts, including aircraft and ordnance, are still present in the area (Figs. 10–11). Local guide services are available at modest cost to tourists and other visitors.

The Biotic Environment

Although Paijmans (1976) believed that no native plants are restricted to ultrabasics, there is mounting evidence that such substrates are in fact associated with substantial endemism. In addition to the presence of localized endemics, serpentine environments are also noted for distributional anomalies, particularly by taxa occurring at elevations far below their usual centers. This pattern is especially pronounced on the Bowutu ultrabasics, where the *Massenerhebung* effect of coastal mountains (see Grubb 1971; Grubb & Stevens 1985; Whitmore 1975) combines synergistically with substrate effects. Many low-elevational records can be expected from such situations, since the KWMA is PNG's only conservation locality where serpentine communities are disposed in a continuous sequence from sealevel to cloudy summits.

Nearly all information from Bowutu environments are from easily-studied coastal localities. The montane and inland areas have been neglected despite their presumed biotic significance. In recognition of these deficiencies, the Bowutu Range is included among PNG's 16 terrestrial unknown areas and as one of the five most critical watersheds requiring conservation action (Sekhran

FIG. 10. Unexploded US 500 lb GP bomb from the KWMA. Explosives recovered from WWII-vintage munitions are often used in near-shore fish dynamiting, a practice implicated as a principal cause of reef damage and declining fish stocks. Such bombing is illegal in PNG and is also outlawed under the KWMA's organic rules (Anonymous, Sept. 19, 1996), but the prohibitions are not vigorously enforced. Photo Karol Kisokau.

& Miller 1995). Johns (1993) had listed the district with 42 other localities of greatest floristic importance for PNG. The estimate of 4,000+ plant species for the area is among the highest of any existing conservation site (ibid.).

In 1997 a multidisciplinary survey was concluded within the KWMA, focusing primarily on marine and land-fauna documentation (Bein et al. 1998; Bein 1999). The botanical inventory started in 1998 immediately after the animal surveys had ended. Taken collectively, the biotic assessments have examined coastal and alluvial swamps, lowland rainforest, premontane foothill forest, and mossy cloud forest. The collections density (CD: 890 plant specimens per 100 sq km) is very high by Papuasian standards, but this figure is misleading because much of the collecting has been confined to the lowlands.[6] The montane communities are still poorly known, even though most of the floristic diversity is probably concentrated at the higher elevations. Approximately 20 new plant species have been discovered during the ongoing investigations (Huynh 2001, 2002; Pipoly & Takeuchi in submission; Stevens in submission;

[6]The overall CD for Papuasia is only 30 collections per 100 sq km (Frodin 1990). The atypical nature of the Kamiali sampling coverage is evidenced by the near-absence of collections from above 500 m elevation. In other PNG environments, the montane areas are usually much better known than the lowland habitats.

Fig. 11. Rusting 81 mm mortar shells from the KWMA. In 1943 Nasau Bay was the site of an amphibious assault by the US 32nd Division and a land attack from Wau by the Australian 32 Bde (Burns 1991). Photo Karol Kisokau.

Takeuchi 2001, 2003b). The findings obtained to date provide evidence of a continuing potential for discovery in one of PNG's most distinctive floristic environments.

MATERIALS AND METHODS

In contrast to Rapid Biological Assessments, the botanical survey was based on a plan involving numerous visits to the KWMA. Fieldtrips of 1–2 weeks duration were conducted at ca. 4 month intervals during the 4-year survey. With a schedule of repeated visits, fertile specimens were acquired throughout the year, and even infrequently-flowering taxa could be collected. Because of the KWMA's logistical advantages, studies employing such itineraries can achieve a more complete and cost-effective coverage than efforts based on single visits. The benefits of conducting small-area inventories over extended periods of time have been discussed by earlier commentators (e.g. Prance 1977).

Forest communities were examined by walk-through collecting and visual assessment, operating either from campsites established in the bush, or from the KWMA science facilities at Lababia Ridge and Kulindi (Figs. 12–14). The explorations were generally confined to the lowland zone below 500 m. Plant collections were usually made in sets of 3–5 duplicates, but if a specimen was believed to have special significance, this was increased to ca. 10 duplicates. At

FIG. 12. Parataxonomists collecting along the Saia River.

the Kulindi Science Center, electric generators enabled gatherings to be dried by artificial heat immediately after collecting in adjacent forests. Otherwise when operating from bushcamps, the gatherings were field-pressed in newsprint and plastic bags, then soaked with 70% ethanol for subsequent processing in Lae (Fig. 15). Silica-dried samples for DNA sequencing were also obtained if specialists had placed earlier requests for assistance.

In Appendix 1, the survey specimens have been tabulated together with earlier numbers from the ultrabasics at Buso and Kui.[7] The ultrabasic boundary extends southeast from Kui village, passing immediately inland from Braunshweig Harbor at Siboma (Simpoma). Specimens from Kui are appended with a (K) on the checklist, to indicate when the material is from the ultrabasic boundary and may have been obtained from non-serpentine terrain. Natter Bay and Paiewa represent Tertiary substrates of different age and origin from the Bowutu ultrabasics (Dow & Davies 1964), and are thus omitted from the compilations.

The Paiewa drainage is intersected by an extensive network of logging tracks along which a few collections were made under the NGF series (e.g. *Gillison NGF 22489–22500, 25011–25049*). Some of the upstream areas at Paiewa are inside the ultrabasic belt, but the locality data are too ambiguous to determine the substrate status of such collections. Jacobs's numbers from 'opposite

[7]Author citations for binomials are provided in the text for names which are not in the appendix.

FIG. 13. Bulili Ridge. Survey team in ultrabasic forest.

Fig. 14. The Kamiali Science Center facilities at Kulindi, on the beachfront of Nasau Bay. Natural-growth ultrabasic forest is immediately adjacent to the compound. A substantial number of undescribed taxa have been discovered in the general area.

Lasanga Island', are similarly difficult to interpret with respect to their substrate association.

Much of the methodology and rationale for the Kamiali surveys have been discussed elsewhere (Takeuchi 2003a). As with many recent efforts, the itinerary was implemented by village teams involving institutional parataxonomists D. Ama, Nathan, and/or A. Towati, or as a larger workforce supervised by colleague B. Siga and the writer.

GENERAL DESCRIPTION OF THE VEGETATION

The physiognomy of the KWMA lowland flora is similar to a montane forest, with a preponderance of small-leaved species and a general absence of vining, cauliflorous, or compound-leaved plants (Fig. 16). Plank-buttressed trees are rare. To some extent, these characteristics are due to the anomalous presence of higher-elevation species in lowland habitats. Many sealevel distributional records were documented by the recent surveys (e.g. see discussion on *Astronidium morobiense*).

The KWMA regrowth phase (between sealevel to at least ca. 500 m elev.) is dominated by *Commersonia bartramia*, *Decaspermum bracteatum*, *Dicranopteris*

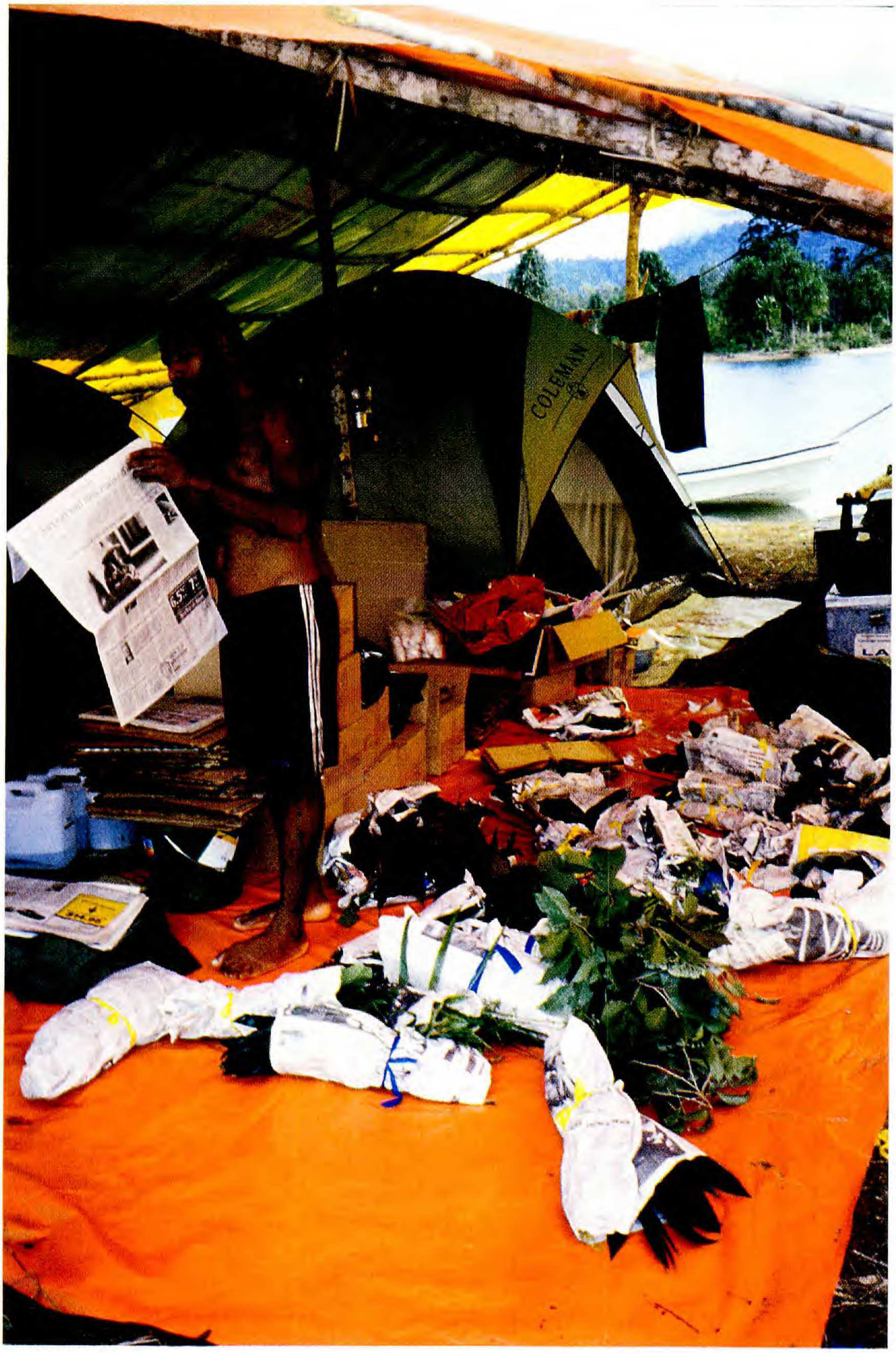

FIG. 15. Processing of plant specimens in the field. Gatherings are individually wrapped in newsprint to protect the collections during the trek back to basecamp, where they are then packed in ethanol.

Fig. 16. The Bulili ultrabasic forest extends to the highwater line on Nasau Bay.

linearis, *Myrtella beccarii*, *Schuurmansia henningsii*, and *Timonius paiawensis*. Many of the seral or pioneer taxa normally found in Mamose environments are absent or uncommon.[8] *Cyathea*, *Cypholophus*, *Dendrocnide*, *Endospermum*, *Glochidion*, *Gouania*, *Leea*, *Macaranga* (except for *M. bifoveata*), *Mallotus*, *Musa*, *Mussaenda*, *Omalanthus*, *Pipturus*, and *Trichospermum* are conspicuously missing or are insignificant in the floristic succession on ultrabasics (Fig. 17). Even the aggressive weed *Piper aduncum* rarely manages to establish in seemingly opportune situations. Similar patterns have been noted in the Raja Ampat serpentine district of Irian Jaya (Takeuchi 2003b).

Within the lowland ultrabasic flora as a whole, a number of ordinarily speciose families are clearly under-represented. The impoverished groups include Araceae, Begoniaceae, Combretaceae, Dilleniaceae, Gesneriaceae, Malvaceae (sens. str.), Marantaceae, Moraceae, Urticaceae, Verbenaceae, and Vitaceae. The representation by ferns and their allies is also poor in comparison to regular substrates at comparable levels of rainfall.

[8]Mamose is the administrative region in northern PNG consisting of *Ma*dang, *Mo*robe, and the *Se*pik provinces. The name is an acronym formed by the first two letters of the provinces, and is also rendered as 'Momase', by the same procedure. Although 'Mamose' is universally understood within PNG, its use is virtually unknown outside the country. There is a certain utility in its usage, because the word refers by coincidence to a part of PNG defined by tectonic and biotic similarities, and thus represents a discrete evolutionary environment.

Fig. 17. Fire succession in the former burn area shown in figure 6. After 4 years, the regrowth consists mainly of *Macaranga bifoveata* (shrubs in photo) and *Machaerina glomerata*. Other colonizers are *Trema cannabina* and *Commersonia bartramia*.

In addition to the impoverished groups, floristic depauperation is further evidenced by the absence of several families which should be present in lowland environments of northern PNG. The families which were not seen included Commelinaceae (notably *Amischotolype* and *Pollia*), Cycadaceae, Dichapetalaceae, Hernandiaceae, Opiliaceae, Ruscaceae (*Dracaena angustifolia* Roxb.), and Tetramelaceae (*Octomeles sumatrana* Miq.). In contrast, Euphorbiaceae, Myrtaceae, and Rubiaceae (except for *Ophiorrhiza* and *Mussaenda*) are exceptionally common. Other families represented by large numbers of individuals are Burseraceae, Clusiaceae, Cyperaceae, Meliaceae, Myristicaceae, Myrsinaceae, and Pandanaceae. However there is an obvious general reduction in floristic diversity, as evidenced by the low species counts relative to other New Guinea environments. The PABITRA transect investigations are currently providing quantitative data for defining these patterns (Sengo in prep.).

One direct consequence of low alpha diversity in KWMA habitats is the disproportionate presence of a small group of plants. Certain taxa are nearly everywhere in the lowland ultrabasic forest. Among understory shrubs and subshrubs, these 'weedy' elements include *Casearia* aff. *erythrocarpa* (sp. ?nov.), *Conandrium polyanthum*, *Fittingia tubiflora*, *Geniostoma rupestre*, *Ixora* sp. (sp. A on checklist), and *Syzygium trivene* sens. str. The understory fern *Lindsaea obtusa* is the most ubiquitous pteridophyte. *Anisoptera thurifera* ssp. *polyandra*, *Hopea glabrifolia*, *Myristica chrysophylla*, *Syzygium furfuraceum*, and *Tristaniopsis macrosperma* are similarly abundant in tall-growth canopy. *Gymnostoma papuana* (exposed ridges and riverbanks) and *Stenocarpus moorei* (streambanks and landslips) often form locally monodominant stands in repetitively disturbed habitats. The subcanopy and middle layers in hill forest below 500 m are dominated particularly by *Brackenridgea forbesii*, *Canarium* spp., *Garcinia* spp., *Gordonia papuana*, *Gymnacranthera farquhariana* var. *zippeliana*, *Haplolobus floribundus*, *Polyosma* cf. *forbesii*, and *Syzygium effusum* sens. lat.

The KWMA lowland vegetation is thus characterized by a limited number of very common species. The disharmonic nature of the flora is similar to insular environments from more isolated stations within the Pacific, and the prevailing patterns are reversed to some extent only in the coastal and alluvial flats bordering the major waterways. In such locations, some of the missing taxonomic elements reappear, presumably due to a reduction in soil toxicity. Alluvial substrates in the KWMA have acidity values to pH 4, unlike the ultrabasic substrates on ridges (Bein, pers. comm. March 2000). There are thus two general floristic associations within the lowland KWMA: 1) a macrophyllous, liane-rich community characteristic of riverine/swampy environments, and 2) a highly disharmonic ultrabasic flora of contrasting generic composition and with some of the attributes of a montane vegetation.

Although *Alyxia acuminata* sens. lat., *Freycinetia* spp., *Hugonia jenkinsii*,

and *Psychotria olivacea* are moderately common in ultrabasic forest, climbing taxa are generally notable by their absence or rarity. Apocynaceae (Asclepiadoideae), *Calamus*, Convolvulaceae (with the exception of *Erycibe*), *Dichapetalum*, *Flagellaria*, *Gouania*, Lomariopsidaceae, *Mucuna*, *Stenochlaena*, *Tecomanthe*, *Uncaria*, and all Vitaceae, are often absent or rare even from open streamcourses and other edge environments where such taxa are ordinarily prevalent. Understories are also remarkably clear, and physical passage through the forest is decidedly easier than with most lowland communities.

On the current forest mapping system for PNG (Hammermaster & Saunders 1995a, b) the Bowutu ultrabasic vegetation is primarily classified as a small-crowned lowland hill forest (code Hs, ibid.), reflecting the overall stunting of the serpentine canopies. KWMA ultrabasic stands are easily detected in aerial photos because of their depauperate appearance, changing only at the transition to regular substrates, where the canopy develops larger, medium-sized crowns (code Hm, e.g. at the Kui ecotone).

In contrast to ultrabasic communities, the alluvial habitats are primarily seral environments, often *Gymnostoma*-dominant and subject to seasonal flooding. These riverine successional areas are generally restricted to the coastal floodplains where the KWMA's clear-flowing streams emerge onto the lowlands (see Hammermaster & Saunders 1995b: Salamaua SB 55-15 overlay). In other low-lying sections near the coast, like the beachfront opposite Lababia Island, the presence of poorly drained flatland is associated with *Metroxylon*-monodominant swamps (Wsw; ibid.). The coastline vegetation also includes scattered seagrass shallows (*Enhalus acoroides*), *Bruguiera*-*Rhizophora* mangroves, and tidal estuarine forest (Fig. 18), but the areas encompassed by such communities are below the resolution of existing vegetation maps.

DESCRIPTIONS OF NEW SPECIES

RUBIACEAE

Psychotria bulilimontis Takeuchi, sp. nov. (**Figs. 19–21**). Type: PAPUA NEW GUINEA. Morobe Province: Kamiali Wildlife Management Area, lower slopes of Bulili Mt, multistoried ultrabasic forest, 07° 18.5' S, 147° 07.5' E, 20 m, 6 Oct 2002 (fl, fr), *W. Takeuchi & D. Ama 16428* (holotype: LAE!; isotypes: A, BISH, BO, BRIT, CANB, K, L, MO, NSW, US).

Species haec ab aliis congeneribus papuanen inflorescentiis lateralibus fructibus globosisque rhachidi inflorescentiarum teretibus statim distinguitur.

Understory shrub 3–4 m in height, erect, often polelike, sparingly or moderately branched, outer bark thin, dark gray, smooth. **Branchlets** terete, slightly compressed at the top, subapical diam. 2–3(–4) mm, spreading, weak, surfaces green in the leaf-bearing intervals, furfuraceous at the stipular scars, otherwise glabrous, internodes (1–)2–6 cm long. **Leaves** diverging in one plane, glabrous; blades fleshy or subcoriaceous, without domatia or cystoliths, adaxially dark

FIG. 18. *Bruguiera-Rhizophora* mangrove forest at Hessen Bay, KWMA.

FIG. 19. *Psychotria bulilimontis* var. *bulilimontis* in the ultrabasic forest on Bulili Ridge. White arrow: stem base of the type individual.

FIG. 20. *Psychotria bulilimontis* var. *bulilimontis*. The type gathering (*W. Takeuchi & D. Ama 16428*).

FIG. 21. *Psychotria bulilimontis* var. *bulilimontis*. Closer view of the fruit and cymules (*W. Takeuchi & D. Ama 16428*).

green, abaxially mid-green, bifacially olivaceous after drying, linear-elliptic, (7–)12–21 by (1.5–)3.5–6.5 cm, apex gradually acuminate, margins entire, base cuneate, equal; venation pinnate, secondaries 7–12 pairs, (7–)10–22 mm apart, at the lamina center diverging 55–70° from the midrib, arcuate, brochidodromous, tertiary nervation areolate, all venation plane or weakly raised on upper surfaces, prominulous beneath; petiole 8–20 by 1.0–2.0 mm, adaxially channelled or flattened, rounded beneath; stipules valvate, linear-acuminate, to 15 by 4 mm, brownish-green, caducous, adaxially furfuraceous at the base, otherwise glabrous, apex bifid, the arms 3–4 mm long, filiform. **Inflorescence** axillary from the subapical and lower nodes, glabrous, lax, paniculiform, ultimately cymose, the primary branches opposed or 3-verticillate, all axes spreading, light green, delicate (0.5–1.0 mm wide); peduncle (10–)50–85 mm long, primary branches to 25 mm long; peduncular bracts caducous; rachis bracts persisting at the branching points, acuminate, 1–3 mm long; floral bracts triangular, minute. **Flowers** (measurements from spirit-preserved material) tetramerous, glabrous on exterior surfaces, 5.0 mm long, sessile; calyx infundibular, 2.7 by 1.8 mm, limb dentate, teeth ca. 0.2 mm long, erect at anthesis; corolla sympetalous, valvate, white, tube 2 mm long, pilose in a 1 mm wide band at the mouth, lobes ovate, 2.0–2.5 by 1.8 mm, apex acute; stamens alternipetalous, erect, glabrous, anthers exserted, oblongoid, ca. 0.8 mm long, basifixed, introrse, filaments very short, attached at the sinus; gynoecium glabrous, ovary globular, recessed at the summit, style included, ca. 0.6–0.7 mm long, stigma lobes ca. 0.5 mm long, coherent. ***Fruits*** shiny orange-red when ripe, juicy, subglobose, 5 mm diam. *in vivo*, crowned by the calycine residue; pyrenes 2, pale yellow-brown, 2–3-ridged on the back, inside farinaceous, no ruminations.

Distribution and ecology.—*Psychotria bulilimontis* is known only from lowland environments within the Kamiali Wildlife Management Area. The nominate variety is restricted to the ultrabasics.

Etymology.—The epithet commemorates the type locality.

PARATYPE: **PAPUA NEW GUINEA. Morobe Province:** Kamiali Wildlife Management Area, lower slopes of Bulili Mt, multistoried ultrabasic forest, 07° 18.5' S, 147° 07.5' E, 20 m, 25 Aug 2002 (fl, fr), *W. Takeuchi, D. Ama, B. Siga, & Nathan 16416* (A, L, LAE!).

Axilliflorous *Psychotria* are rare in New Guinea. Only *P. axilliflora* Merr. & Perry and *P. dipteropoda* Laut. & K. Sch. are known to flower from subapical nodes. The new species is easily distinguished from its axilliflorous congeners by the globose fruits (fusiform and compressed in *P. axilliflora*) and by the delicate, terete axes of the inflorescence (conspicuously flattened and broad in *P. dipteropoda*).

Psychotria bulilimontis var. **aestuarii** Takeuchi, var. nov. (**Figs. 22–23**). TYPE: PAPUA NEW GUINEA. MOROBE PROVINCE: Kamiali Wildlife Management Area, banks of the Saia River near Hessen Bay, alluvial-estuarine forest, 07° 21.6' S, 147° 07.3' E,

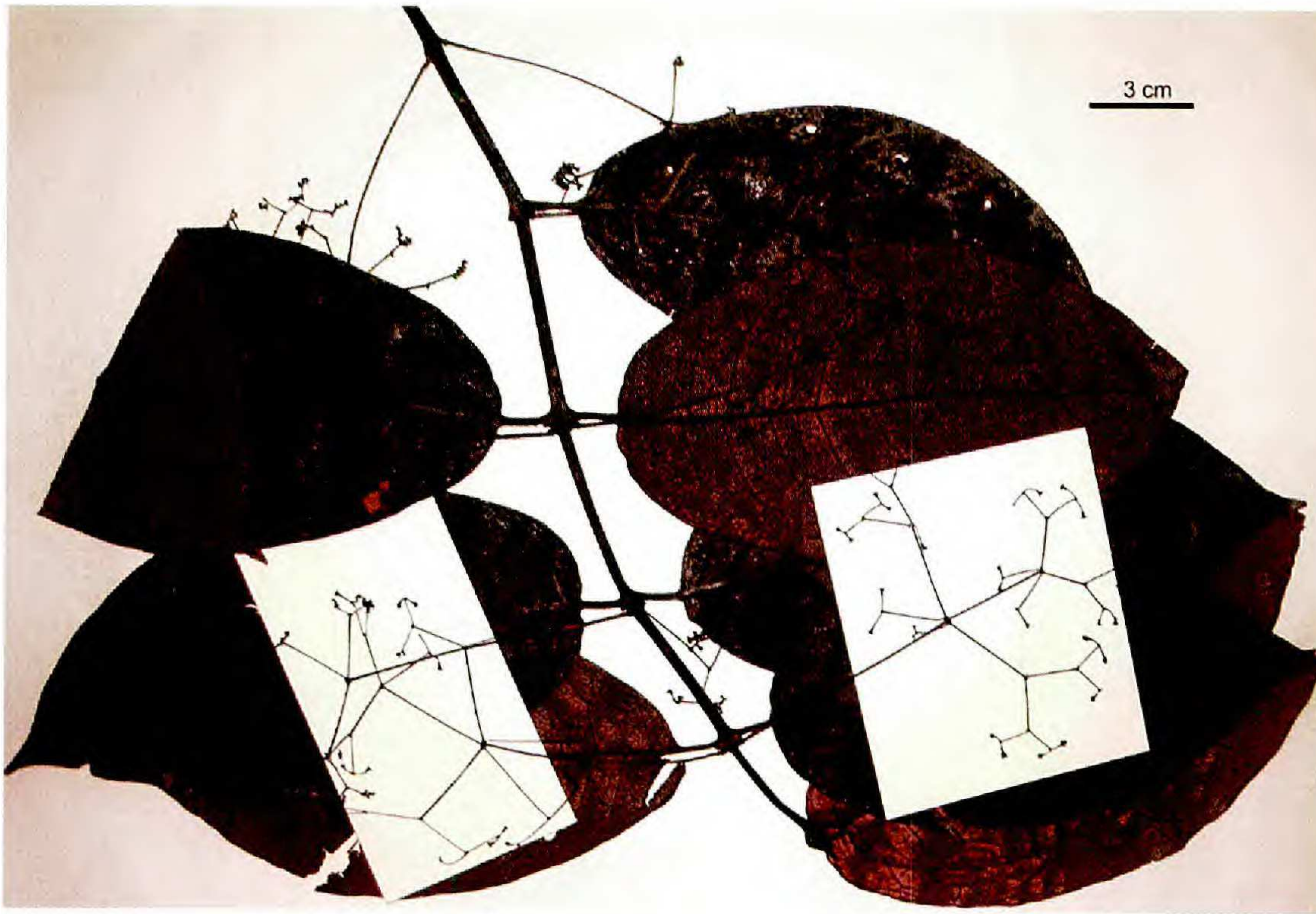

Fig. 22. *Psychotria bulilimontis* var. *aestuarii*. An unmounted duplicate from the type gathering. The delicate, umbelliform inflorescence is characteristic (*W. Takeuchi, B. Siga, & A. Towati 14993*).

Fig. 23. Hessen Bay. Estuarine forest habitat of the type population for *Psychotria bulilimontis* var. *aestuari*.

5–10 m, 15 Jan 2001 (fl), *W. Takeuchi, B. Siga, & A. Towati 14993* (HOLOTYPE: LAE!; ISOTYPES: A, BISH, BO, CANB, K, L, MO, US).

Ab var. *bulilimonti* laminis latioribus ad bases rotundatis vel cordatis, indumento denso denique inflorescentiis umbelliformibus praeclare distinguitur.

Understory shrub 1–2(–4) m in height, erect, sparingly or moderately branched. **Branchlets** obliquely ascending, weakly compressed near the summit, terete below, subapical diam. 2–4 mm, hirtellous, hairs persisting, internodes (2–)4–7(–11) cm long. **Leaves** distichous, spreading; lamina usually fleshy, adaxially dark dull green, abaxially pale green or brownish-green, discolorous after drying, turning black or fuscous above and rufous-brown beneath, upper surfaces glabrous, marked by linear cystoliths or not, lower surfaces hirtellous, hairs orange- or reddish-brown, densest on midribs and veins, domatia absent; blades variable, narrowly to broadly elliptic, ovate, or obovate, (9–)13–23 by (3–)6–11 cm, apex acuminate, margins entire, base subcordate, rounded, (or cuneate); venation pinnate, secondaries 10–12 pairs, (7–)15–20(–28) mm apart, at the lamina center diverging (35–)50–70° from the midrib, arcuate, more or less brochidodromous but reticulating freely beyond the commissural loops, tertiary nervation conspicuously and coarsely areolate, all venation plane or impressed on upper surfaces, prominulous beneath; petiole 5–20 by 1.5–2.0 mm, adaxially channelled or flattened, rounded beneath, indument like the branchlets; stipules valvate, caducous, lanceolate-ovate, to 15 by 5 mm, apex bifurcately divided into 3–4 mm long filiform caudae, exterior surfaces coarsely hairy, inside furfuraceous-barbate along the base, otherwise glabrous. **Inflorescence** axillary from the subapical and lower nodes, umbelliform or paniculiform, the ramifications verticillately branched for 1–3 orders, ultimately cymose, all axes spreading, lax, hirtellous, delicate (0.5–1 mm wide), dull light green; peduncle (10–)35–95 mm long, primary rays to 31 mm long, secondary rays to 16 mm long; peduncular bracts caducous, linear-acuminate, to 3.0 by 0.5 mm; rachis bracts subpersisting at the branching points, acuminate, ca. 1 mm long; bracteoles triangular, ca. 0.5 mm. **Flowers** (measurements from spirit-preserved material) tetramerous, 5.0 mm long, sessile; calyx tubular, 2.0 by 1.5 mm, puberulent, limb dentate, teeth reflexed at anthesis; corolla sympetalous, valvate, white, outer surfaces glabrous, tube 1–2 mm long, mouth pilose, lobes oblong, 2.6–2.7 by 1.2–1.3 mm, apex obtuse or acute; stamens alternipetalous, erect, glabrous, anthers oblongoid, ca. 0.5 mm long, basifixed, introrse, filaments very short, attached at the sinus; gynoecium glabrous, ovary recessed at the summit, style exserted, ca. 4.5 mm long, stigma conspicuously bilobed. **Fruits** immature, globose.

Distribution and ecology.—Known only from coastal forests in the Kamiali Wildlife Management Area.

Etymology.—The varietal name reflects the estuarine forest habitat of the type population.

PARATYPES: **PAPUA NEW GUINEA. Morobe Province:** Kamiali Wildlife Management Area, banks of the Saia River near Hessen Bay, alluvial-estuarine forest, 07° 21.6' S, 147° 07.3' E, 5–10 m, 15 Jan 2001 (fl), *W. Takeuchi, B. Siga, & A. Towati 14990* (A, L, LAE!); ditto, *W. Takeuchi, B. Siga, & A. Towati 14995* (A, BO, K, L, LAE!, MO); ditto, *W. Takeuchi, B. Siga, & A. Towati 15002* (A, BISH, BO, CANB, K, L, LAE!, MO, US).

Variety *aestuarii* is clearly referable to *Psychotria bulilimontis*. The lax and delicate inflorescence from lowermost axils is very distinctive and characteristic of the species. However unlike the nominate variety, the alluvial plants are very hairy shrubs with broad leaves and a pronounced tendency for umbelliform branching on the inflorescence. In contrast, the ultrabasic populations (var. *bulilimontis*) are essentially glabrous, with narrow leaves gradually tapered at both ends, and a more paniculiform inflorescence. Both varieties have heterostylous flowers.

SALICACEAE

Trichadenia sasae Takeuchi, sp. nov. (**Figs. 24–27**). TYPE: PAPUA NEW GUINEA. MOROBE PROVINCE: Kamiali Wildlife Management Area, base of Bulili Ridge at Kulindi, ultrabasic forest, 07° 18' S, 147° 08' E, 0–5 m, 4 Feb 2003 (fr), *W. Takeuchi, D. Ama & B. Siga 16561* (HOLOTYPE: LAE!; ISOTYPES: A, BO, CANB, K, L).

Species haec ab aliis congeneribus laminis cordatis usque ad 31.5 cm longisque 27.0 cm latis, dense velutinis fructibus magnis 4 cm diametris perfacile recognoscitur.

Canopy tree 25 m tall, unbuttressed, highly branched, outer bark gray, thick, rough-textured, slash orange-brown, without exudate, sapwood pale yellow. **Branchlets** terete, 12–15 mm in diam. below the leaf spray; indument subpersisting, orange-brown velutinous, usually with a monolayer of erect septate hairs, sometimes also with an underlayer of crispate hairs; periderm dark gray, longitudinally fissured; abscission scars conspicuous, patelliform, 4–10 by 7–12 mm. **Leaves** spirally congested in apical tufts, spreading; blades coriaceous, bichromatic *in vivo*, adaxially dark green, abaxially yellowish-green, olivaceous *in sicco*, the mature laminae manifestly cordate, 22.5–31.5 by 20.5–27.0 cm, apex obtuse, (emarginate, or mucronate), margins entire or irregularly repand, depth of basal sinus (2.0–)2.5–4.0(–5.5) cm; upper surfaces pilosulous on veins, glabrescent between, lower surfaces velutinous; venation plinerval-palmatiform at the petiole, pinnate above the base, craspedromous, secondaries 5–8, (15–)30–70(–85) mm apart, at the lamina center diverging (45–)50–55(–60)° from the midrib, straight (or arcuate), sometimes sparingly anastomosing before the margin, tertiary nerves scalarifom, reticulum conspicuously and bifacially areolate, adaxially impressed, all venation prominent below; petioles strictly cylindrical, 5–10 cm by 2.5–4.0 mm on apical leaves, progressively longer on lower leaves (to 18 cm by 5.0 mm), swollen at both ends, geniculate, indument like the branchlets; stipules caducous, subulate, 7–12 mm long, densely hairy. **Flowers** unknown. **Infructescence** solitary from axils of attached leaves, densely velutinous; peduncle ca. 10 mm long, rachis terete, 10–20 by 3–7 mm, unbranched;

FIG. 24. *Trichadenia sasae*. Crown form of the type individual (*W. Takeuchi, D. Ama & B. Siga 16561*).

bracts linear-acuminate, 1.5–2.0 mm long, caducous; pedicels 1.5–3.0 by 5–6 mm, articulated at the rachis. **Fruits** indehiscent, pendulous, globose, 40–43 by 38–43 mm, bilobed or obscurely trigonous, (38–47 by 46–55 mm), epicarp pale grayish-brown through all stages of maturation, lenticellate, laxly hirtellous (glabrous to naked eye), surface scrape bright green, no exudate, pericarp thin (ca. 1 mm), crustaceous, entire *in vivo*, usually collapsing and coarsely rugose after drying; mesocarp at first straw-pale brown, later yellow and baccate, ripe pulp fleshy, no odor; seeds 1-3, endosperm copious, white, turning pink after sectioning.

Distribution and ecology.—*Trichadenia sasae* is known with certainty only from the closed-canopy forest bordering Nasau Bay. All confirmed sightings have occurred on the ultrabasics.

Etymology.—The new species is named after colleague Sasa Zibe-Kokino, a professional forester and prominent conservation advocate, currently serving as the Member of Parliament for Huon electorate.

PARATYPE: **PAPUA NEW GUINEA. Morobe Province:** Kamiali Wildlife Management Area, base of Bulili Ridge at Kulindi Science Center, ultrabasic forest, 07° 18' S, 147° 08' E, 0–5 m, 25 Nov 2001 (fr), *W. Takeuchi, D. Ama & B. Siga 15589* (A, BO, CANB, L, LAE!, MO, US).

The genus *Trichadenia* was previously represented in the Malesian region only by the widely distributed *T. philippinensis* Merr. A second species (*T. zeylanica*

FIG. 25. As for figure 24, looking into the crown from below.

Fig. 26. *Trichadenia sasae*. Detached branchlets from the type gathering.

Fig. 27. *Trichadenia sasae*. Parataxonomist Demas Ama holds a fruiting branchlet against the bole.

Thwait.) is endemic to Ceylon (Sleumer 1954). The new *Trichadenia* is easily recognized by its large cordate leaves, dense indument, and large fruits.

The field appearance of *T. sasae* is similar to the *Sterculia ampla-macrophylla* complex and is thus almost impossible to identify from a distance. The type tree was for several years misidentified as a *Sterculia* due to the gross similarities in habit. There are apparently several individuals of this species along the Bulili coast but few have been seen in fertile condition. The species is not common within the KWMA.

NOTES ON OTHER TAXA

CONVOLVULACEAE

Erycibe spp.—*Erycibe* is generally an uncommon genus in PNG. When last treated by Hoogland (1953a, b) and Oostroom (1953, 1955), most taxa were known from only a small number of specimens. The current species concepts are ill-defined, in part due to the former scarcity of materials for study and by what appears to have been an excessive splitting of the variation. As is generally true of canopy lianes with brightly colored fruits and inconspicuous flowers, most of the modern gatherings consist of fruiting material which are less useful than flowering ones. The genus is greatly in need of revision.

In contrast to most PNG localities, *Erycibe* is well represented within KWMA alluvial habitats, but all existing specimens are in fruit and cannot be keyed out. While many Morobe collections are apparently conspecific with the KWMA species, none of the sheets has been reliably identified and the assigned names seem to have been taken up by successive collectors in uncritical fashion. The KWMA *Erycibe* are neither rare or new, but the difficulties involved in their identification are symptomatic of a greater problem with the genus as a whole.

CYPERACEAE

Cladium mariscus (L.) Pohl sens. lat.—A cosmopolitan species, but rare in New Guinea and not previously recorded for PNG (Hay 1984). LAE has no recent accessions from New Guinea other than the survey voucher.

FABACEAE

Maniltoa sp. (Verdcourt sp. E)—The only *Maniltoa* recorded in the ultrabasic lowlands is apparently an undescribed taxon closely related to *Maniltoa schefferi* K. Sch. & Hollrung. On Verdcourt's (1979) alphabet list of novelties, the KWMA plants are referable to species E, distinguished by sessile ovaries and fruits. *Maniltoa* E is very common within the hill forest and consistently maintains its separate character. There are no transitional forms to *M. schefferi*. The KWMA *Maniltoa* is apparently restricted to the serpentine zone and is arguably best regarded as a subspecies. In other characters, species E is so similar to *M. schefferi* that it would be inappropriate to establish a new species on just one differentiating trait.

LECYTHIDACEAE

Barringtonia spp.—At least five species of *Barringtonia* have been documented on the ultrabasics (*B. apiculata*, *B. asiatica*, *B. lumina*, *B. pinifolia*, and *B. racemosa*; see Jebb 1991). KWMA *Barringtonia* are partitioned by habitat into two groups, with *B. asiatica* and *B. racemosa* occurring mainly along the coast, and the remaining species ranging into the upper drainages and interior hill forest. *Barringtonia pinifolia* is particularly common within alluvial communities near the base of the main range. In comparison, the distinctive *B. lumina* was seen only a few times along the Saia River and is apparently rare.

Barringtonia is widely employed as a fish poison in lowland New Guinea (ibid.; Payens 1967; Peekel 1984) but Kamiali villagers apparently use only *Derris trifoliata* ('rop dynamit') for fishing. This situation is certainly not due to a lack of availability, since *Barringtonia* spp. are present in large, easily-accessed populations around the main village and fishing camps. Some respondents claim that *Derris* is more effective on the reefs than *Barringtonia*, but this assessment is not universal. Although the use of plant poisons for fishing is a well-established practice in Kamiali society, it has been traditionally discouraged except in special circumstances (Martin 1998, 1999). The growing frequency of reef bombing and *Derris* 'dynamiting', are manifestations of the changes occurring within Kela society, and of the declining influence of customary observances.

MALVACEAE

Sterculia sp. nov., aff. **ampla-macrophylla** group
Sterculia sp. ?nov., aff. **shillinglawii** F.v.M.
The KWMA has two possible novelties in *Sterculia*.

Tantra (1976: 75–6) regarded *Jacobs 9639* from the Buso-Kui foothills as a new species in the *ampla-macrophylla-morobeensis* group, but formal description was deferred pending acquisition of more complete material. No new collections have been made since the initial gathering in 1973. A series of numbers from the current survey also cannot be identified with Tantra's conspectus (ibid.), and may represent another undescribed species.

MELASTOMATACEAE

Astronidium morobiense Maxw. (**Figs. 28–29**).—The species was previously known only from mossy fagaceous forest between 1350–1800 m near Wagau (Maxwell & Veldkamp 1990). However recent determinations (ex S.S. Renner, pers. comm. March 2003) indicate that the species is distributed southwards along the Morobe coast as far as Natter Bay, with occurrences in both ultrabasic and non-serpentine habitats.

In marked contrast to the environment specified in its protologue, the KWMA populations of *A. morobiense* are found primarily at low elevations. On Bulili Ridge, the species is even found at sealevel, immediately behind the highwater line and in forest occasionally subject to saltwater damage. Between

FIG. 28. *Astronidium morobiense*, in the sealevel ultrabasic forest near Kulindi, KWMA.

FIG. 29. As for figure 28, showing the inflorescence (*W. Takeuchi & D. Ama 16223*).

Lokanu-Tambu Bay and Kui village (Fig. 5), the only remaining hill forest is on the headlands bordering Sachsen and Hessen Bays (e.g. Cape Dinga and Cape Roon). The communities in or near these areas often have taxa at their lowest elevations of record (e.g. *Astronidium morobiense*, *Bhesa archboldiana*, *Gnetum costatum*, *Hunga papuana*, *Lophopetalum torricellense*, *Mackinlaya schlechteri*, *Nastus schlechteri*, *Ormosia calavensis*, *Paphia*, *Psychotria archboldii*, and *Syzygium richardsonianum*).

MYRSINACEAE

Fittingia urceolata Mez and **F. tubiflora** Mez (**Figs. 30–31**).—These obviously related species are sympatric and vegetatively indistinguishable. *Fittingia urceolata* is noticeably more frequent on the ultrabasic substrates than its congener, but the two often occur side by side outside the serpentine (e.g. the foothills at Paiewa). The only distinction between the species is in the color of the drupes (red for *F. tubiflora* and white for *F. urceolata*; Sleumer 1988).

Sleumer (ibid.) suggested the apparent difference in fruit color might not be an adequate basis for discrimination between the species, although he accepted the separation in his revision. Field observations from the recent surveys show that the color contrasts are indeed consistent and effective discriminators. In *F. tubiflora* the red color is evident even in the ovary of the anthetic flower (label data for *14429*) and is preserved as the fruit develops through a marble-like phase and eventually into the spongy-textured drupe from which the generic name is derived. Whether or not a species pair should be upheld on the basis of a single contrasting character is a matter of subjective judgment, but the color distinction is certainly not some transient feature related to fruit maturation—i.e. white fruits do not ripen into red fruits or vice versa. It may be more appropriate to relegate the taxa to varietal rank, but in any event, there is a readily detectable difference in living material.[9]

MYRTACEAE

Syzygium trivene (Ridley) Merr. & Perry and **S. lorentzianum** Laut.—*Syzygium lorentzianum* was known to Hartley and Perry (1973) only from the type. The species is supposedly distinguished from *S. trivene* by slight differences in leaf form and by the longer flower buds (ibid.: 177).

Within the KWMA, *S. trivene* sens. str. is one of the most common subarborescent taxa of riverine understories and interior forest. From examination of the survey's many numbers, it is evident that the characters separating this species from *S. lorentzianum* are part of an intergrading series of variation. In general, *S. lorentzianum* is the name of a robust form growing in exposed areas (e.g. along streambanks) while *S. trivene* is the spare variant of closed

[9]Most of the survey duplicates were distributed indicating a synonymy between the names (i.e. as *F. tubiflora* = *F. urceolata*.

FIG. 30. *Fittingia urceolata*. The pericarp is hyaline green in the immature fruit, but turns opaquely white with ripening (*W. Takeuchi, A. Towati, B. Siga, & M. Kavua 16172*).

FIG. 31. *Fittingia tubiflora*. In contrast to the congener, fruits are red from the start of their development (there is no green phase). The initially hard pericarp becomes spongy-textured and somewhat juicy when ripe (*W. Takeuchi, B. Siga, & A. Towati 14991*).

forest. The distinctions appear environmentally determined and thus undeserving of formal recognition. *Syzygium trivene* should be regarded as a synonym of *S. lorentzianum*, since the latter has the older epithet.

POACEAE

Nastus schlechteri (Pilger) Holtt., or aff.—The condensed panicles and aristate basal glumes are distinctive. Apparently known only from the type (*Schlechter 19720*), which was not seen by Holttum (1967) and presumably lost at Berlin.

The KWMA collections are from atypically low elevations for the genus, having been obtained from ca. 100 m, but the vouchers otherwise conform to Holttum's species description and the key (ibid.).

RUBIACEAE

Psychotria archboldii Sohmer, **P. mayana** Takeuchi, **P. melanocarpa** Merr. & Perry—Indument and fruit color are the principal means for separating these taxa. *Psychotria archboldii* is entirely glabrous on all parts, while *P. mayana* and *P. melanocarpa* have stelliform hairs. Although *P. archboldii* has red fruits, the drupes are white in *P. mayana* and black in *P. melanocarpa*. The three species are apparently geographically separated. Only *P. archboldii* var. *archboldii* has an appreciable distribution, occurring from Morobe to Milne Bay and offshore islands (var. *multinervia* is known by a single collection from Gulf Province), while *P. mayana* and *P. melanocarpa* have been found only in Madang and Western Provinces, respectively. Apart from these distinctions, the plants are obviously related and can be plausibly regarded either as sibling species, or as geographically separate subspecies. Herbarium specimens from the *archboldii-mayana-melanocarpa* complex are visually striking, with bright orange-brown or rufous leaves. The large fruits are invariably jet black on exsiccatae, irrespective of the coloration *in vivo*.

In *P. archboldii* as a whole, there is considerable doubt about the fruit color, a character widely employed by Sohmer (1988) as a basis for species separations among the Papuasian congeners. Although variety *archboldii* is recorded as having red fruits, the KWMA populations of this variety were collected with white drupes. The fruits of *P. archboldii* var. *multinervia* are also supposedly white, according to the label for the only existing specimen (though the variety was formally described as having red fruits).

The discrepancies could be explained if *P. archboldii* has distinct color phases with the fruit maturing from white to red, or less plausibly from red to white. However such color changes have never been substantiated for any Papuasian *Psychotria*. If fruit color has no significance in this species complex, the present separations should be dismantled and recognition given only to geographic subspecies or races.

Psychotria croftiana Sohmer—*Psychotria croftiana* is a large-leaved species pre-

viously known from three fruiting collections on the Huon coast (Sohmer 1988). It is a common and conspicuous shrub in the ultrabasic forest but also occurs on the nonserpentine substrates southeast of Buso. The distinctively papillate-hairy flowers were unknown until the recent surveys. A supplementary description of the flowering plant can be provided from the new material:

Inflorescence paniculate, pyramidal, exceeding the leaves at anthesis, to 37 by 29 cm, all axes glabrous; peduncle 7–13 cm long, first order branches 3–4-verticillate, to 17 cm long; rachis bracts acuminate, 2–6 mm long, abruptly subulate at the apex, subpersisting, abaxially glabrous, adaxially furfuraceous at the base; floral bracts inconspicuous, linear or linear-acuminate, ca. 0.5 mm long; pedicels 1–2 mm long; cymes lax. **Flowers** (measurements from rehydrated material) 5(–6)-merous, 2.5 by 3.5 mm at anthesis; calyx infundibular (shallowly cupular when dry), parted about halfway to the base, lobes triangular, equal, ca. 0.5 mm long; corolla white, obovoid in bud, tube 1.7 by 1.8 mm, glabrous on all exterior surfaces, mouth not clearly barbate, lobes adaxially papillate-hairy, acute, 1.0 by 1.2 mm, reflexed at maturity; stamens alternipetalous, anthers erect, oblongoid, 0.6–0.7 mm long, filaments short, inserted about halfway down the tube; gynoecium glabrous, ovary dome-shaped, recessed at the top, style 0.7 mm long, stigma 0.3 mm long, slightly expanded, columnar, 5–6-sulcate, not or only weakly exserted.

Specimens examined: **PAPUA NEW GUINEA. Morobe Province:** Kamiali Wildlife Management Area, lower slopes of Bulili Mt, ultrabasic forest, 07° 18.5' S, 147° 07.5' E, 40 m, 6 Oct 2002 (fl), *W. Takeuchi & D. Ama 16430B* (A, BO, CANB, K, L, LAE!, MO, US); base of Lababia Ridge, ultrabasic forest, 07° 16' S, 147° 06' E, 75 m, Oct 2002 (fl), *W. Takeuchi & D. Ama 16578* (A, LAE!).

Psychotria waiuensis Sohmer—*Psychotria kamialii* Takeuchi, Edinburgh J. Bot. 58:159–161. 2001. TYPE: PAPUA NEW GUINEA. MOROBE PROVINCE: Kamiali Wildlife Management Area, 1.5 km W of Lababia Village, 07° 17' S, 147° 06' E, 5–10 m, 14 Nov 1999, *W. Takeuchi & J. Sengo 14310* (HOLOTYPE: LAE; ISOTYPE: K).

Current fieldwork indicates that the recently described *Psychotria kamialii* must unfortunately be regarded as a synonym of *P. waiuensis*. As the most obvious point of distinction from its closest congeners, the monocaulous habit of *P. kamialii* was the principal character used to establish that species. Because of an emphasis on architectural form, the equivalence to *P. waiuensis* was overlooked. There are several points which can be made in relation to the synonymy.

First, it is very unlikely that *P. waiuensis* is a 10 feet (3 m) tall shrub as indicated in the diagnosis. *Psychotria waiuensis* is not rare, and every plant seen during the recent surveys were monocaulous dwarfs occurring as helophytes in shallow mud or standing water. In this respect the plant is similar to the higher elevation forms of *P. ramadecumbens* Sohmer. The type gathering for *P. kamialii* for example, was a colony sample from sago swamp, taken from separate 0.5 m individuals. The KWMA populations have never been seen growing on firm ground as medium-sized branching shrubs. Although *P. waiuensis* is described

as 'about 3 m' (Sohmer 1988) this figure is probably a label error. It is more plausible that the first collections at Waiu Bay (Braunschweig Harbor on most maps) were also monocaulous subshrubs, as suggested by the fact that the earlier sheets show no indication of branching. Most of the bayfront at Waiu is a coastal swamp similar to the type locality for *P. kamialii*, so a general stunting of woody plants would also be expected at the earlier collection site. Because the actual habit of this swamp species was not appreciated, Sohmer's (1988) key will go astray at fork 107, where there is a couplet separation between monocaulous and branching shrubs. *Psychotria waiuensis* will actually key out to *P. inconspicua* Merr. & Perry, as happened during the initial evaluation of *P. kamialii*.

As presently known, *P. waiuensis* occurs only between Kamiali and Waiu, an area consisting mainly of ultrabasics. However future collectors will probably find this species further south along the coastline, since the swampy forests which the plant inhabits are not restricted to serpentine. Judging from its current habitats, *P. waiuensis* may be present in the coastal wetlands near the Morobe-Waria Rivers, where extensive areas of comparable environment can be found.

Coastal swamps are such disagreeable places that it is easy to understand why only one collection existed of *P. waiuensis* prior to the recent surveys, even though the species is moderately common. The presence of saltwater crocodiles (*Crocodilus porosus*) and swarms of mosquitos are disincentives to loitering in these shoreline areas. The most promising strategy for collectors is to work the ecotone along the margins of the swamps, rather than their interior parts. If the putative differences between *P. waiuensis* and *P. kamialii* are derived from substrate conditions, different growth forms should be found at the contact between swamp and dry land.

SALICACEAE

Homalium d'entrecasteauxense Craven—Formerly known only by the type collection from Normanby Island (Craven 1979). In the survey vouchers, stamens are consistently arranged in 3-membered fascicles. Branchlets are puberulent.

Steenis (1982) expressed doubt over the number of new species recognized by Craven (1979), and of their distinction from the variable *H. foetidum* (Roxb.) Benth. The taxonomic issues are still unresolved because of the limited number of specimens available for study (7 out of the 10 Papuasian species are known only from the types). Multiple collections showing the variation within individual populations are much needed.

The new gatherings from the KWMA suggest that staminal number is an effective criterion for splitting *H. d'entrecasteauxense* from the *foetidum* complex. This separation is corroborated in the field by differences in stature and habit. The Kamiali specimens of *H. d'entrecasteauxense* were taken from frail,

4 m tall understory shrubs, but *H. foetidum* is ordinarily a robust timber-sized tree. The survey specimens also confirm the differences in indument between *H. d'entrecasteauxense* and *H. maneauense* Craven (see modified key in Steenis 1982: 564).

THELYPTERIDACEAE

Plesioneuron croftii Holtt.—Formerly known in the literature only by the type collection from Natter Bay, but now also represented by newer material from the Waria basin and Buso.

Plesioneuron croftii is similar to *P. dryas* Holtt., differing primarily in the color of the aerophores (dark in *P. dryas* and pale in *P. croftii*; see Holttum 1981). The recent collections are closest to *P. croftii* but have dark aerophores, and seem to combine characteristics of that species and its congener. Although the position of the sori near costules is of some value in the identification of *P. croftii* (ibid: 399), the distinction is small and inconstant, and probably unworthy of specific rank.

DISCUSSION

Whether or not floristic patterns discerned in the KWMA are of general application to other floras is unknown, especially as the ultrabasic patterns are difficult to separate from those applying to the Papuan Peninsula as a whole. Although the distribution of ultrabasic substrates can be extracted from the geological literature, information on the associated vegetation is sparse and unsubstantiated. There are no checklists or forest descriptions of representative formations anywhere in PNG. The patterns found at Kamiali may be unique to the Bowutu communities, but at least within the KWMA, the lowland serpentine has been sampled to very high intensities, and is presently one of the better known lowland floras in New Guinea. Approximately 1,915 specimens have been compiled from a lowland area of 215 sq km, for a collections density (CD) of 890 collections per 100 sq. km.[10] The current checklist includes 130 families, 412 genera, and ca. 710 morphospecies. Most of the lowland taxa from the Kamiali area have probably been recorded. In view of the general depauperation of serpentine floras, the species counts primarily reflect the sampling saturation achieved by the surveys, rather than any special richness of the serpentine plant life. At Josephstaal for example, an inventory of lowland rainforest below 400 m recorded a total of 139 families, 445 genera, and 730 morphospecies (Takeuchi 2000), an outcome very similar to the Bowutu study. However the

[10]Stevens (1989) notes that the current benchmark of 50–100 collections per 100 sq km does not necessarily represent a well-collected locality. The Bowutu inventory demonstrates that even at much higher sampling intensities, unknown taxa will escape detection. Once an adequate baseline has been established for a specific flora, further progress will be dependent on how additional collections are distributed through space and time, rather than the mere acquisition of more material.

Josephstaal assessment involved only one month of survey work, while the ultrabasic itinerary was much more intensive, consisting of repeated fieldtrips over a period of four years.

The results at Kamiali have been constrained by the surveys' strict and deliberate focus on the lowland zone below 500 m. On Mt Kinabalu, the speciose character of the vegetation has been attributed primarily to the presence of ultrabasic outcrops in the montane elevations (Beaman & Beaman 1990). Species counts in the KWMA are likely to increase considerably when investigations are extended into the higher habitats where most of the diversity in New Guinea environments are probably concentrated. A substantial number of Bowutu taxa have already been typified from NGF collections made at Lake Trist (elev. 1800 m), mainly by Henty in 1966 (*NGF 29004–29138*). Many of these montane serpentine records are still known only from the original collection, a situation similar to the Kinabalu ultrabasics (ibid.). Existing evidence suggests that a fair number of species remain undiscovered. Unlike Mt Kinabalu however, the KWMA lowland ultrabasics have relatively few species, which for the most part are already well-represented in collections from Buso, Kamiali, and Kui. The recent high-intensity surveys have started to reveal the presence of rarer endemics such as *Discocalyx kaoyae*, *Paphia megaphylla*, and *Trichadenia sasae*. *Mammea papyracea* (*NGF 39414*), *Pouteria gillisonii* Vink (*NGF 25627*), and *P. pullenii* Vink (*NGF 25625*), known only from their types, are also probably rare plants from the ultrabasics (cf. Stevens 1995; Vink 2002).

Despite the extensive work done by earlier botanists at Buso and Kui, the lowland ultrabasics are still a fruitful venue for new material. Even supposedly well-collected localities can be a source of floristic discovery when exploration routes are slightly altered from the previously-used tracks (Stevens 1989). The recent discoveries are a case in point. Papuasian collectors often retrace the field itineraries of previous investigators due to the convenience of following well-used trails. Yet because plant distributions are typically very patchy across seemingly homogeneous or comparable habitats (Oatham & Beehler 1998), slight changes in exploration schedules can be immensely productive. In the KWMA, adjacent ridges often have very different compositions and species frequencies even across the same geological substrates (Sengo in prep.).

Some idea of the conspicuous contrasts in plant distributions and frequencies can be seen when comparing the collections from Buso and Kamiali. For example, *Kairothamnus phyllanthoides* and *Plesioneuron croftii* are common at the former locality, but have not yet been recorded from immediately adjacent Kamiali habitats. Conversely, although *Psychotria bulilimontis* and *Timonius* sp. ?nov. are plentiful in the KWMA hill forest, they have yet to be collected at Buso. Distributional peculiarities are further exemplified by plants that are essentially restricted to the ultrabasics, having high frequencies inside

the KWMA, but which are also known from one or two collections on normal substrates elsewhere on the Papuan Peninsula (e.g. *Astronidium morobeense*, *Guioa grandifoliola*, *Hunga papuana*, and *Zanthoxylum novoguineense*).

Patchiness of the plant distributions on ultrabasics occurs over a range of spatial scales. At one end, are the localized differences reported by Oatham and Beehler (1998) at Lakekamu. These may be due to the dynamic fragmentation of the forest caused by disturbances such as storms and changes in streamcourse. On a larger scale, plant distributions can vary markedly along different ridges or rivers, even though there are no obvious habitat factors separating the occurrences (Frodin 1990; Grubb & Stevens 1985; Kalkman & Vink 1970). The different levels of patchiness have obvious implications for floristic exploration. Perfunctory surveys will probably miss many of the most significant plants, particularly those with quirky distributions. These difficulties are compounded by unpredictable phenologies and the resulting element of chance in the results achieved by surveyors.

Within the Bowutu tract, taxa endemic to the ultrabasic belt include *Calophyllum streimannii*,[11] *Discocalyx kaoyae*, *Freycinetia curvata*, *F. kamialiensis*, *F. mediana*, *F. rubripedata*, *Kairothamnus phyllanthoides*, *Myristica filipes*, *Paphia megaphylla*, *Psychotria bulilimontis* var. *bulilimontis*, and *Solanum symonianum*. The percentage of strict endemics in the local flora is small compared to more extreme environments (e.g. the Waigeo ultrabasics in Irian Jaya, where rainfalls are much lower than in the KWMA; cf. Takeuchi 2003b). Humid conditions appear to reduce the intensity of effects from serpentine substrates. An inverse relationship between rainfall and the severity of the serpentine syndrome has been noted for other areas (e.g. Kruckeberg 1985).

An overwhelming majority of the KWMA species occur on both sides of a serpentine contact, although there are apparent differences in relative frequencies when passing across such boundaries. The floristic contrasts are primarily ones of degree rather than quality. With so many lowland areas being altered by anthropogenic development, the natural distributions of many native species will become difficult to determine in the future. This will complicate comparative studies on PNG's ultrabasic ecosystems . Most of the coastal habitats south of Kamiali are now fragmented by logging damage, and the real range of plants comprising the Papuan Peninsular flora is increasingly obscured by forest destruction.

In view of the general connection between serpentine effects and rainfall, the growing incidence of El Niño-associated droughts is likely to result in future floristic change which will amplify existing patterns. As rainfalls are reduced, ultrabasic effects should increase, and floristic distinctions across the substrate contact at Kui will become more acute. This is likely to be accompanied by a

[11]But *C. streimannii* may be present in Western Province (see Stevens 1995).

sharper physiognomic discontinuity at the contact (i.e. a more obvious reduction in tree statures and crown densities across the boundary). Floristic attenuation can be expected to involve mainly the generalist species that lack serpentine-coping mechanisms. Since many of these plants (e.g. *Canarium*) are used by Kamiali villagers, a reduction in forest ethnobotanical values is probable. Future changes in beta-diversity patterns can also be anticipated in the montane parts of the ultrabasic belt. The KWMA's mossy forests above 500 m were severely affected by the recent El Niño episodes of 1997–98 and 2002. Repeated droughts could result in a lifting of the ecotone and an associated degradation of watershed services.

APPENDIX 1. LOWLAND PLANTS RECORDED FROM KAMIALI

Voucher source for occurrence record: LAE = collections from the Lae Herbarium institutional (new) series; NGF = collections from the New Guinea Force series; nv = non visus, specimen not found at LAE but cited in the literature and/or entered in LAE logbooks; sn = sin numéro (without number); SR = sight record; numbers without prefix = W. Takeuchi et al. (usually with D. Ama, B. Siga, and/or A. Towati). Other collectors indicated by name.

The checklist is a compilation of collections (below ca. 500 m) from the ultrabasic zone between Kamiali and Kui. Specimens from the present survey have been determined by WT unless otherwise noted. Determinations to earlier collections are based on annotations from published revisions or from specialist tickets on herbarium sheets.

FERNS AND FERN ALLIES

ADIANTACEAE

Acrostichum speciosum Willd.; 14896

Adiantum hollandiae v.A.v.R.; 15228

Pityrogramma calomelanos (L.) Link; 15062

Syngramma borneensis (Hook.) J. Smith; 14468

Syngramma grandis (Copel.) C. Chr.; LAE 52303 (nv); NGF 45222

Taenitis blechnoides (Willd.) Sw.; 14642, 14659; Kog 30; NGF 44261; Palis 27

ASPLENIACEAE

Asplenium laserpitiifolium Lam.; 14722, 14840, 14915, 14917

Asplenium cf. *musifolium* Mett.; 14705

Asplenium nidus L. var. *nidus*; 14702; Unkau 96

Asplenium phyllitidus Don ssp. *malesicum* Holttum; NGF 45123, 45124; Palis 30

ATHYRIACEAE

Callipteris prolifera (Lam.) Bory; 15242

Diplazium cordifolium Bl.; NGF 45175

Diplazium esculentum (Retz.) Sw.; 15251

BLECHNACEAE

Blechnum orientale L.; 14613

Blechnum vittatum Brack.; 14815, ?14973, 15059, 15102

Stenochlaena milnei Underw.; SR, Tabali riverbanks

CYATHEACEAE

Cyathea macgillivrayi (Bak.) Domin; 15036, 15356

Cyathea werneri Ros.; 14881

Cyathea sp., subsection *Sarcopholis*; 15205

DAVALLIACEAE

Davallia heterophylla Sm.; 14615B, 15390; NGF 24493

Davallia parvula Hook. & Grev.; 14391

Davallia pectinata Sm.; 14411, 14538

Davallia repens (L.f.) Kuhn; 15215

Davallia solida (G. Forst.) Sw. var. *solida*; 14358, 14539, 14686, 15225

DENNSTAEDTIACEAE
Hypolepis tenuifolia (Forst. f.) Bernh. ex Presl; 15067
Pteridium aquilinum (L.) Kuhn; 15060

DRYOPTERIDACEAE
Dryopolystichum phaeostigma (Cesati) Copel.; 14554, 14646, 14685, 14878; Manseima 19; Palis 19

GLEICHENIACEAE
Dicranopteris linearis (Burm. f.) Underw. var. *subferruginea* (Hieron.) Nakai; 14609, 15052

GRAMMITIDACEAE
Ctenopteris blechnoides (Grev.) Wagner & Grether; 14776, 14794, 15141, 15172, 15214; Conn et al. 208; NGF 45189; Palis 31

HYMENOPHYLLACEAE
Hymenophyllum sp. (*Mecodium*); 15231
Trichomanes (*Cephalomanes*) *atrovirens* Kunze; 14895, 15183; Akia 17; Gawi 22; Ron 28
Trichomanes (*Selenodesmium*) *obscurum* Bl.; 14674, 15185; Damas 1; Palis 29; Rau 288
Trichomanes sp., *Nesopteris-Selenodesmium* group; 16619

LINDSAEA GROUP
Lindsaea ensifolia Sw. ssp. *agatii* (Brack.) Kramer; 14608, 15336
Lindsaea ensifolia Sw. ssp. *ensifolia*; 15140
Lindsaea ensifolia Sw. x ?*L. obtusa* J. Smith; 14880
Lindsaea gueriniana (Gaud.) Desv.; 14326, 14668, 14789, 14842, 15352, 16433; Gawi 24
Lindsaea kingii Copel.; 15226; NGF 39415
Lindsaea obtusa J. Smith; 14319, 14390, 14407, 14649, 14669, 14690, 15174B, 15180, 15440; Gawi 23; NGF 45125
Lindsaea repens (Bory) Thwaites var. *sessilis* (Copel.) Kramer; 15186; NGF 39420
Sphenomeris retusa (Cav.) Maxon; 14996
Tapeinidium longipinnulum (Ces.) C. Chr.; 15196; Gawi 27; NGF 45126, 45127

LYCOPODIACEAE
Huperzia cf. *carinata* (Poiret) Trevisan; 14716, 14932
Huperzia phlegmaria (L.) Rothm.; 14710, 14843, 15211
Huperzia squarrosa (Forst. f.) Trevisan; 14812
Palhinhaea cernua (L.) Vasc. & Franco; 14643, 15051

MARATTIACEAE
Marattia sp., aff. ?*megaptera* Copel.; 15155, 15158, 16598

OLEANDRACEAE
Nephrolepis falcata (Cav.) C. Chr.; 14621
Nephrolepis hirsutula (Forst.) Presl; 15232

OPHIOGLOSSACEAE
Ophioglossum pendulum L. f. *pendulum*; 14914; LAE 51690; NGF 45223

PARKERIACEAE
Ceratopteris thalictroides (L.) Brongn.; 15253

POLYPODIACEAE
Drynaria rigidula Bedd.; 14536
Drynaria sparsisora (Desv.) T. Moore; 14657, 14950
Lecanopteris deparioides (Ces.) Baker; 15223, 16635; NGF 45219
Lecanopteris sinuosa (Wall. ex Hook.) Copel.; 14546, 15079; Bellamy B12; NGF 44206
Microsorum scolopendria (Burm. f.) Copel.; 14360
Microsorum sibomense Copel.; NGF 45182
Pyrrosia foveolata (Alston) Morton var. *foveolata*; 15261

PSILOTACEAE
Psilotum nudum (L.) Beauv.; 14637

PTERIDACEAE
Pteris blumeana Agardh; 14684, 14717
Pteris tripartita Sw.; 15061, 15073, 15077

SCHIZAEACEAE
Lygodium microphyllum (Cav.) R. Br.; 14610
Lygodium trifurcatum Baker; 14406, 14563, 14758, 14836, 14844 (distr. as *L. dimorphum*)
Lygodium versteegii Christ; 14323, 15103, 15182; Gawi 25; Kairo 752; NGF 44201
Schizaea dichotoma (L.) Sm.; 15171; Jacobs 9545; Kog 27; Kwangut 33; NGF 47773
Schizaea digitata (L.) Sw.; 14324, 15006; NGF 39417
Schizaea wagneri Selling; NGF 45170

SELAGINELLACEAE
Selaginella cf. *schlechteri* Hieron.; 14409
Selaginella cf. *suffruticosa* v.A.v.R.; Palis 32
Selaginella sp., aff. ?*melanisica* Kuhn; 14809
Selaginella sp. (possibly: *latifolia*, *puberulipes*, or *suffruticosa*); 15195
Selaginella sp.; Akia 18

TECTARIA GROUP
Tectaria bamleriana (Rosenst.) C. Chr.; SR, Bulili; NGF 45220
Tectaria durvillei (Bory) Holttum; NGF 22884 (K, nv)
Tectaria sp., aff. ?*cristovalensis* (C. Chr.) Alston; NGF 22884 (K)

THELYPTERIDACEAE
Plesioneuron croftii Holttum; Conn et al. 177; Manseima 26 (?23, two nos. given on label)
Pneumatopteris sogerensis (Gepp) Holttum; 15267
Sphaerostephanos multiauriculatus (Copel.) Holttum; 15270
Sphaerostephanos sp., aff. *novoguineensis* (Brause) Ros.; 14753, 14961, 15010, 15107

VITTARIACEAE
Antrophyum sp., *callifolium* Bl. facies; SR, Lababia
Monogramma sens. lat., closest to *Vaginularia trichoidea* Fee; Kwangut 37
Vittaria angustifolia Bl.; 15391; Unkau 98
Vittaria elongata Sw. var. *angustifolia* (Bory) Thw.; 15216
Vittaria elongata Sw. var. *elongata*; Manseima 20
Vittaria cf. *scolopendrina* (Bory) Thw.; 14775

GYMNOSPERMS

GNETACEAE
Gnetum costatum K. Sch.; 14320, 14765, 14965, 15415, 15420, 15577, 16579, 16586; Conn et al. 296; NGF 25677
Gnetum gnemon L. var. *gnemon*; 14739, 14741, 14764, 14783, 16562; LAE 68531
Gnetum latifolium Bl. var. *latifolium*; 14952

PODOCARPACEAE
Podocarpus neriifolius D. Don; 14330, 15086, 15110; NGF 28082A (K)

MONOCOTS

AMARYLLIDACEAE
Crinum asiaticum L.; SR, Tabali riverbanks

ARACEAE
Colocasia esculenta (L.) Schott; SR, cult. Lababia
Cyrtosperma macrotum Becc. ex Engl.; NGF 45172
Holochlamys beccarii Engl.; NGF 25681
Scindapsus sp.; 14638, 15080
Spathiphyllum schlechteri (Engl. & Krause) Nicolson; 15157, 16595; Conn et al. 205, 217, 237; LAE 51676; NGF 45149; Vinas & Kairo 311, 312, 314, 317
Xanthosoma sagittifolia (L.) Schott; SR, cult. Lababia

ARECACEAE
Areca cathecu L.; SR, cult. Lababia
Calamus hollrungii Becc.; SR, Saia River
Calamus sp., aff. *brevifolius* Becc.; 14956; NGF 24479 (nv)
Calamus spp.; 14426; Jacobs 9561, 9698; NGF 24469
Calyptrocalyx sp., aff. ?*stenochista* Burret; 14398
Calyptrocalyx sp.; Kjaer AB511
Caryota rumphiana Mart.; SR, Kulindi
Cocos nucifera L.; SR, cult. Lababia
Cyrtostachys glauca H.E. Moore; NGF 24460
Cyrtostachys sp.; Kjaer AB 512
Heterospathe cf. *muelleriana* (Becc.) Becc.; Kjaer AB 513
Hydriastele microspadix Becc.; 14547, 15043, 15142; LAE 52052; NGF 24427, 24477
Livistona sp. nov.; Kjaer AB 514; NGF 24466, 25682
Metroxylon sagu Rottb.; SR, Tabali River
Nypa fruticans Wurmb; SR, Tabali River
Orania lauterbachiana Becc.; NGF 24435, 24480
Orania sp.; Kjaer AB 515

BROMELIACEAE
Ananas comosus (L.) Merr.; SR, cult. Lababia

CYPERACEAE
Cladium mariscus (L.) Pohl sens. lat.; 14630
Cyperus pedunculatus (R. Br.) Kern; LAE 52301
Cyperus rotundus L. ssp. *retzii* (Nees) Kük.; 14974
Eleocharis geniculata (L.) R. & S.; 14533B; LAE 52324; NGF 44152, 44203
Fimbristylis cymosa R. Br.; 14531, 14533A
Gahnia aspera (R. Br.) Spreng.; 14578, 15063
Hypoletrum nemorum (Vahl) Spreng.; LAE 52340
Machaerina glomerata (Gaud.) Koyama; 14443, 14790, 14805, 15337, 16569; LAE 72468; NGF 28098 (K), 39432
Machaerina mariscoides (Gaud.) Kern; 14850, 16571; LAE 52327
Machaerina rubiginosa (Spreng.) Koyama; 14629
Mapania baccifera C.B. Clarke ssp. *baccifera*; 14573, 14658
Mapania macrocephala (Gaud.) K. Sch.; 14396, 14818

Mapania macrocephala (Gaud.) K. Sch. ssp. *macrocephala*; 14791; Conn et al. 262; LAE 52290
Paramapania parvibractea (Clarke) Uittien; 14640, 14656, 15083, 15563, 16612
Schoenus falcatus R. Br.; 14624, 14762, 14849
Schoenus laevinux (Kük.) Ohwi; 14907
Scleria ciliaris Nees sens. lat.; 15122, 15441
Scleria polycarpa Boeck.; 14862

DIOSCOREACEAE
Dioscorea alata L.; SR, cult. Lababia
Dioscorea esculenta (Lour.) Burk.; SR, cult. Lababia
Dioscorea nummularia Lamk.; 14346, 15070

FLAGELLARIACEAE
Flagellaria indica L.; 14331, 14564, 14930

HYDROCHARITACEAE
Enhalus acoroides (L.f.) Royle; Jacobs 9693; NGF 45190

LAXMANNIACEAE
Cordyline fruticosa (L.) A. Chev.; 14457, 14732, 14826, 15044, 16439; NGF 24453

MARANTACEAE
Phacelophrynium sp.; 14645 (distr. as *Phrynium* sp.), 16611

MUSACEAE
Musa cultivars; SR, cult. Lababia

ORCHIDACEAE (Vogel et al. colls. det. by Vogel & Schuiteman; other colls. det. by Howcroft)
Acriopsis javanica Reinw. ex Bl. var. *javanica*; 14412, 15262; NGF 45194
Acriopsis liliifolia (J. Konig) Ormerod; Vogel et al. 20030827
Agrostophyllum spp.; 14601; Vogel et al. 20030853
Apostasia wallichii R.Br.; 14415, 14748, 15202; LAE 51677; Vogel et al. 20030793, 20030832
Appendicula reflexa Bl.; Vogel et al. 20030791
Appendicula spp.; 15229; Vogel et al. 20030789, 20030790
Ascoglossum calopterum (Rchb. f.) Schltr.; 16443
Bromheadia finlaysoniana (Lindl.) Miq.; 16568; Vogel et al. 20030831
Bulbophyllum blumei (Lindl.) J.J. Sm.; 15201
Bulbophyllum gracillimum (Rolfe) Rolfe; Vogel et al. 20030823, 20030837, 20030838
Bulbophyllum cf. *macranthum* Lindl.; 14594
Bulbophyllum sessile (Koen.) J.J. Sm.; Vogel et al. 20030818
Bulbophyllum sp., sect. *Aphanobulbum*; 15389
Bulbophyllum sp., sect. *Sestochilus*; Vogel et al. 20030807, 20030814, 20030817
Bulbophyllum spp.; 15392; LAE 52323; NGF 31624; Vogel et al. 20030808, 20030809, 20030810, 20030811, 20030812, 20030813, 20030815, 20030816, 20030817, 20030829, 20030836, 20030855
Cadetia funiformis (Bl.) Schltr.; NGF 45195 (det. Schuiteman); Vogel et al. 20030800
Cadetia sp./?spp.; 15213; NGF 45121 (no flowers)
Ceratostylis sp.; 14641
Claderia cf. *papuana* Schltr.; Vogel et al. 20030788
Claderia sp.; Vogel et al. 20030856
Cleisostoma spp.; Vogel et al. 20030850, 20030851
Coelogyne asperata Lindl.; 15154, 15219
Coelogyne cf. *fragrans* Schltr.; Vogel et al. 20030796
Dendrobium austrocaledonicum Schltr.; 15071
Dendrobium bracteosum Reichb.; SR, Saia River
Dendrobium coeloglossum Schltr.; Vogel et al. 20030804
Dendrobium hosei Ridl.; 15227; LAE 52310 (600 m elev.)
Dendrobium lawesii F.v.M.; LAE 52307, 52308, 52309 (600 m elev.)
Dendrobium ?lineale Rolfe; SR, Saia River
Dendrobium macrophyllum A. Rich; 14597, 14599; Vogel et al. 20030843, 20030845, 20030846
Dendrobium spectabile (Bl.) Miq.; 14603; LAE 52330: NGF 45191; Vogel et al. 20030822, 20030842
Dendrobium viridiflorum F.M. Bailey; Vogel et al. 20030840
Dendrobium sp., sect. *Amblyanthus*; NGF 45162 (nv)
Dendrobium sp., sect. *Brevisaccata*; Vogel et al. 20030805, 20030857
Dendrobium sp., sect. *Ceratobium*; 15075
Dendrobium sp., sect. ?*Distichophyllae*; Vogel et al. 20030806
Dendrobium sp., sect. *Latouria*; Vogel et al. 20030847
Dendrobium sp., sect. *Oxystophyllum*; Vogel et al. 20030803

Dendrobium sp., sect. *Spatulata*; Vogel et al. 20030828
Dendrobium spp.; 14647; Vogel et al. 20030802, 20030849
Dipodium spp.; Vogel et al. 20030821, 20030835
Eria spp.; NGF 45111; Vogel et al. 20030801
Goodyera rubicunda (Bl.) Lindl.; 15423
Habenaria chloroleuca Schltr.; NGF 25685
Lepidogyne minor Schltr.; 16603; NGF 24478 (nv)
Malaxis sp.; NGF 45161
Neuwiedia veratrifolia Bl.; 14431, 14644, 15096, 15156, 16584; NGF 24478; Vogel et al. 20030833
Paphiopedilum violascens Schltr.; 16618; NGF 45147 (nv)
Phreatia sp.; Vogel et al. 20030852
Plocoglottis sp., *maculata* facies; 15055, 15087, 15159, 16565, 16594; LAE 52037; NGF 31652, 45192, 47762
Plocoglottis sp., *sakiensis* facies; 14353; NGF 25688
Plocoglottis spp.; 14665 (inflorescence terminal); Vogel et al. 20030794
Podochilus sp., *scalpelliformis* facies; 14824
Pseuderia cf. *similis* Schltr.; 14489, 15035, 15187, 15217
Pseuderia spp.; Vogel et al. 20030834, 20030848
Rhynchophreatia sp.; 14622
?*Sarcanthopsis* sp.; 15075, 16443
Spathoglottis plicata Bl.; Vogel et al. 20030820
Spathoglottis plicata Bl. ssp. *humilis* Howcroft ined.; 14397, 14452, 14524, 14631, 15163; NGF 45095, 47766
Spathoglottis portusfinschii Krzl.; Vogel et al. 20030819
Tainia sp.; Vogel et al. 20030798
Tropidia disticha Schltr.; NGF 45122; Rau 286
Tropidia sp.; Vogel et al. 20030797
Vanilla sp.; Vogel et al. 20030786, 20030858
Vrydagzynea novaguineensis J.J. Sm.; NGF 45120
genus indets.; 14352, 14897, 15069 (bottled); Vogel 20030857

PANDANACEAE (Freycinetia dets. by K.L. Huynh)
Freycinetia curvata Huynh; 14347
Freycinetia cyrtocarpa Kaneh.; 16444
Freycinetia erythrophylla Huynh; 15265
Freycinetia funicularis (Sav. ex Lam.) Merr.; 14587, 14589, 14596, 16539; Jacobs 9668; NGF 45225
Freycinetia glaucescens Huynh; 14428
Freycinetia kamialiensis Huynh; 16474
Freycinetia longiramulosa Huynh; 15259
Freycinetia macrostachya Mart.; 14593
Freycinetia mediana Huynh; 15233
Freycinetia neoforbesii Huynh; NGF 45155
Freycinetia oraria Huynh; 14414, 14528, 14731
Freycinetia pluvisilvatica Huynh; 14694
Freycinetia rubripedata Huynh; 16440
Freycinetia sachsenensis Huynh; 14384
Freycinetia takeuchii Huynh; 14351, 14552, 16475
Freycinetia tenuis Solms.; NGF 31628 (K)
Freycinetia sp., ?*marginata* Bl.; NGF 24488 (staminate)
Freycinetia spp.; 14694; LAE 52341 (550 m elev.)
Pandanus cernuifolius Merr. & Perry; 14421, 14442
Pandanus lustrorum Stone, vel aff.; 15559
Pandanus tectorius Parkinson; 14379
Pandanus sp.; SR, Kulindi, 30 m canopy trees

POACEAE
Bambusa forbesii (Ridl.) Holttum; 15360
Bambusa vulgaris Schrad.; SR, Bitoi
Centotheca latifolia (Osb.) Trin.; 15246
Chrysopogon aciculatus (Retz.) Trin.; 14438
Eragrostis cf. *brownii* (Kunth) Nees; 14532
Eragrostis tenella (L.) P. Beauv. ex Roem. & Schult.; 14542
Eriachne triseta Nees ex Steud.; 14530
Ichnanthus vicinus (F.M. Bailey) Merr.; 14816
Ischaemum mutica L.; 14439
Nastus schlechteri (Pilger) Holttum, vel aff.; 14583, 14755, 15235, 15395, 16604, 16642
Paspalum conjugatum Berg.; 14562
Paspalum orbiculare G. Forst.; 14543
Saccharum edule Hassk.; SR, cult. Lababia
Saccharum officinarum L.; SR, cult. Lababia
Sacciolepis indica (L.) Chase; NGF 45193
Urochloa mutica (Forssk.) T.-Q. Nguyen; SR, Kulindi
Zea mays L.; SR, cult. Lababia

SMILACACEAE
Smilax cf. *calophylla* Wall. ex DC.; 14655, 15016, 15561
Smilax cf. *ovatolanceolata* Koyama; 14742, 15023
Smilax sp., '*australis-zeylanica* facies'; 14567

TRIURIDACEAE
Sciaphila tenella Bl.; NGF 45094
Sciaphila sp.; Jacobs 9546; NGF 45144

ZINGIBERACEAE
Pleuranthodium sp., *Psychanthus* facies; 14459, 14957, 14963

Riedelia corallina Val.; NGF 24452
Riedelia cf. *hollandiae* Val.; 16590, 16602, 16617
Riedelia sp. A; ?15049, 16613
Riedelia sp. B; 14383, 14446, 14754, 14960, 16623
Riedelia sp. C; 14403, 14648, 15353, 16610 (14403, 14648 distr. as *Pleuranthodium tephrochlamys*); NGF 24499, 47764

DICOTS

ACANTHACEAE

Acanthus ilicifolius L., sens. lat. (spineless form); 15361
Graptophyllum sp.; LAE 52757 (nv)
Ruellia sp. (*Leptosiphonium*); 15252
Strobilanthes sp.; 15269

ACTINIDIACEAE

Saurauia sp., aff. *schumanniana* Diels; 14356, 14417, 14557, 14579, 14623, 14787, 14918, 15032, 15045, 15443; NGF 25670, 47765; Rau 565

ANACARDIACEAE

Buchanania macrocarpa Laut.; 15221, 16589; NGF 24484
Campnosperma brevipetiolata Volk.; SR, Tabali River
Campnosperma montanum Laut.; 15066; NGF 39416, 45110
Euroschinus papuanus Merr. & Perry; NGF 25666
Semecarpus aruensis Engl.; NGF 45151
Semecarpus australiensis Engl.; Jacobs 9646; NGF 24485
Semecarpus cf. *brachystachys* Merr. & Perry; 14486, 14614, 15005, 15358; NGF 28085 (K)
Semecarpus bracteatus Laut., vel aff.; 14821, 14948, 15046
Semecarpus cassuvium Roxb.; Jacobs 9559; LAE 52336
Semecarpus forstenii Bl.; Jacobs 9594
Semecarpus sp., aff. ?*schlechteri* Laut.; NGF 39436 (nv)

ANNONACEAE

Cyathocalyx cf. *polycarpum* C.T.White (*papuanus-polycarpum* group); 14819, 14910, 15402; NGF 24489 (nv), 28075 (K, nv), 31634 (K, nv), 31642 (K, nv), 45141 (nv)
Goniothalamus aruensis Scheff.; NGF 25663, 45160
Goniothalamus sp.; Jacobs 9539
Haplostichanthus longirostris (Scheff.) Heusden; NGF 25002 (K)
Mitrella sp. (*Fissistigma* s. lat.); 14693, 14912, 15388
?*Petalolophus megalopus* K. Sch., vel aff.; 14652, 15167, 15177 (all nos. without flowers, possibly *Pseuduvaria*)
Polyalthia cf. *oblongifolia* Burck.; NGF 25006 (K), 31638 (K)
Polyalthia spp.; 14865, 16631; Jacobs 9666, 9688; NGF 24456
Pseuduvaria ?*beccarii* (Scheff.) Sincl.; Conn et al. 203, 247; NGF 45137; Rau 613
Pseuduvaria sp., aff. ?*filipes* Laut. & K. Sch.; 14822
Uvaria sp., *cordata-rosenbergiana* facies; 14859, 14913, 14919
Xylopia sp., aff. *peekelii* Diels; 14941, 15580
genus indet.; LAE 52034

APOCYNACEAE

Alyxia acuminata K. Sch., sens. lat.; 14698, 14766, 14977, 14985, 15025, 15145, 16563; LAE 51687, 68554; NGF 28072 (K)
Anodendron oblongifolium Hemsl.; 15433
Cerbera floribunda K. Sch.; 14516, 15344
Cerbera manghas L.; 15134
Hoya lauterbachii K. Sch.; NGF 22888 (nv)
Hoya sp. A; 14720, 14933, 15206, 15240
Hoya sp. B; 15425
Ichnocarpus wariana (Schltr.) Middleton; Jacobs 9687
Melodinus cf. *novoguineensis* (Wernh.) Pichon; 14679
Ochrosia coccinea (Teijsm. & Binn.) Miq.; 14422, 15040
Parsonsia alboflavescens (Dennst.) Mabberley; 14667, 14839, 15133, 15135
Parsonsia buruensis (Teijsm. & Binn.) Boerl.; 15137
Parsonsia curvisepala K. Sch.; 14718, 14853, 14971; NGF 25672, 45128
Sarcolobus retusus K. Sch.; 14354, 14606, 15138, 16566; Bellamy 5; Conn 174; Jacobs 9680; NGF 45114
Tabernaemontana aurantiaca Gaud.; 14395
Tabernaemontana pandacaqui Lam.; 14858, 15224
genus indet.; 15212

ARALIACEAE

Mackinlaya celebica (Harms) Philipson; SR, near Cape Roon

Mackinlaya schlechteri (Harms) Philipson; 14671, 15094, 15190, 15572; NGF 45164
Osmoxylon boerlagei (Warb.) Philipson; 15264
Plerandra stahliana Warb.; NGF 62051
Schefflera sp.; 14797, 14804, 14833

ARISTOLOCHIACEAE

Aristolochia momandul K. Sch.; 14394

ASTERACEAE

Adenostemma lavenia (L.) O. Ktze.; 15248
Bidens pilosa L. var. *minor* (Bl.) Sherff; 14436
Erigeron sumatrensis Retz.; 15204
Wedelia biflora (L.) DC.; SR, near Tabali

BEGONIACEAE

Begonia sp., *brachybotrys-pseudolateralis* facies; 15424

BIGNONIACEAE

Dolichandrone spathacea (L.f.) K. Sch.; 15268
Pandorea pandorana (Andr.) Steen.; 14852
Tecomanthe dendrophila (Bl.) K. Sch.; NGF 24467, 39434

BIXACEAE

Bixa orellana L.; SR, cult. Lababia

BURSERACEAE

Canarium lamii Leenh.; NGF 28060 (K)
Canarium salomonense Burtt; NGF 28092
Canarium vitiense A. Gray; Jacobs 9672
Canarium sp., close to *vitiense* A. Gray; NGF 31648 (K)
Haplolobus floribundus (K. Sch.) H.J. Lam; Jacobs 9673; LAE 52055; NGF 24468

CANNABACEAE

Gironniera celtidifolia Gaud.; 14404, 14708, 14779, 14921, 15378, 16640; LAE 51667; NGF 25680, 47768
Trema cannabina Lour.; 14483, 15064, 15173, 15346; Conn et al. 185, 187; NGF 31633 (K); Rau 563

CARICACEAE

Carica papaya L.; SR, cult. Lababia

CASUARINACEAE

Gymnostoma papuanum (S. Moore) L.A.S. Johnson; 14444, 14778, 14780; NGF 25665

CELASTRACEAE

Bhesa archboldiana (Merr. & Perry) Ding Hou; 15042, 15056, 15074 (distr. as *B. robusta*), 15571
Loeseneriella macrantha (Korth.) A.C. Smith; Jacobs 9619
Lophopetalum torricellense Loes.; 16600; LAE 51684
Salacia chinensis L.; 16425
Salacia erythrocarpa K. Sch.; LAE 52316
Salacia papuana (Loes.) Ding Hou; LAE 52320
Salacia sp.; NGF 45109 (carpological coll. missing, sheet sterile)

CHRYSOBALANACEAE

Hunga papuana (Baker f.) Prance; 14922, 14929, 14940, 15584
Maranthes corymbosa Bl.; 14556, 14712, 14920, 14937, 14942, 14968; NGF 31644 (K)
Parastemon versteeghii Merr. & Perry; 15021; NGF 45157
Parinari papuana C.T. White ssp. *whitei* Prance; 14885, 15015; Jacobs 9583; NGF 28063, 44202

CLUSIACEAE (Calophyllum dets. by P. Stevens)

Calophyllum goniocarpum Stevens; 14981; NGF 24474
Calophyllum inophyllum L.; 14535, 15111; Swaine 66
Calophyllum morobensis Stevens; Johns sn (LAE sheet 129181, nv); NGF 24490 (nv)
Calophyllum papuanum Laut.; 14892, 14905, 15347, 16564; LAE 52312; NGF 24487
Calophyllum streimannii Stevens; LAE 52755; NGF 24285, 24491, 28084 (K)
Calophyllum sp.; 14535
Garcinia cf. *assugu* Laut.; 16632
Garcinia celebica L.; 14416, 14419, 16413
Garcinia dulcis (Roxb.) Kurz; 15406; NGF 28066 (K)
Garcinia hunsteinii Laut.; 15050; NGF 24458
Garcinia latissima Miq.; NGF 24447, 28073
Garcinia cf. *ledermanii* Laut.; 14333, 14348, 14617, 14734, 14867, 15404
Garcinia maluensis Laut.; 15412, 16574; NGF 31646 (K)
Garcinia sinuata Stevens; 14886, 14888, 15169, 15192, 15398, 16583; NGF 24449, 45165
Garcinia sp., *assugu-maluensis* facies; 14651, 14689, 14713, 14729, 14830, 14863, 14890, 14955, 14987, 15001, 15199, 16436; LAE 52761
Garcinia sp., aff. ?*sabangensis* Laut.; 14433, 14769, 14808, 16641

Garcinia sp. ?nov.; *ledermanii* facies but not *Cambogia*; 15379, 15409; NGF 24455
Garcinia spp.; 14325, 14799
Mammea papyracea Stevens; NGF 39414

COMBRETACEAE
Lumnitzera littorea (Jack) Voight; 14378, 14902; LAE 52059; NGF 39092, 44153
Terminalia canaliculata Exell; 15256
Terminalia catappa L.; SR, Lababia
Terminalia rubiginosa K. Sch.; LAE 52043
Terminalia sepicana Diels; NGF 39412

CONVOLVULACEAE
Erycibe cf. *hellwigii* Prain; 14585, 14682; LAE 51691; NGF 24471, 24498, 45100 (keys between *E. carrii* and *E. puberula*)
Ipomoea batatas (L.) Lamk; SR, cult. Lababia
Ipomoea pes-caprae (L.) R. Br.; 14544
Ipomoea pes-caprae (L.) R. Br. ssp. *brasiliensis* (L.) Ooststroom; NGF 22879
Merremia peltata (L.) Merr.; SR, Tabali River

CUCURBITACEAE
Cucumis sativus L.; SR, cult. Lababia

CUNONIACEAE
Ceratopetalum succirubrum C.T. White; sn (sterile)
Weinmannia fraxinea (D.Don) Miq.; 15053, 15054, 15150

DILLENIACEAE
Tetracera nordtiana F.v.M. var. *moluccana* (Mart.) Hoogl.; 15004

DIPTEROCARPACEAE
Anisoptera thurifera (Blanco) Bl. ssp. *polyandra* (Bl.) Ashton; SR, throughout KWMA; LAE 51965, 52039
Hopea cf. *glabrifolia* C.T. White; 14620

EBENACEAE
Diospyros cf. *elliptica* (J.R. & G. Forst.) Green; NGF 28070 (K), 31631 (K), 31632 (K), 31647 (K), 45168, 45169 (some inflorescences cymose but most simple)
Diospyros ferrea (Willd.) Bakh., sens. lat.; 14366, 14555, 14559, 14574, 14715, 14847, 14943, 14975, 15033, 15439 (preceding nos. distr. as *D. elliptica* but inflorescence not cymose), 15387; NGF 39096
Diospyros novoguineensis Bakh.; 15371, 16417; LAE 51679; NGF 24457, 28078 (K), 45148
Diospyros papuana Val. ex Bakh.; NGF 45135
Diospyros cf. *sogeriensis* Bakh.; 15029, 15098, 15381; NGF 24450, 24500
Diospyros sp., ?'*ferrea* group'; NGF 25010 (K)

ELAEOCARPACEAE
Aceratium parvifolium Schltr.; NGF 31627 (K)
Elaeocarpus dolichostylus Schltr. ssp. *dolichostylus*; NGF 45138
Elaeocarpus ledermannii Schltr.; LAE 51670, 52758; NGF 44209, 45129
Elaeocarpus sphaericus (Gaertn.) K. Sch.; 14418, 14548
Elaeocarpus sp., '*sepikanus* group'; LAE 52048
Elaeocarpus sp. ?nov. 5, aff. *miegei* fide Coode; LAE 52295; NGF 25668, 28089
Sloanea pulchra (Schltr.) A.C. Smith ssp. *morobensis* Coode; NGF 25005 (K), 28067 (K), 28096 (K)
Sloanea sogerensis Bak. f., sens. lat.; 14695; Conn et al. 197; NGF 28065 (K), 31649 (K), 45117 (most colls. represent the '*schumannii* facies', cf. Coode 1981)

ERICACEAE
Paphia megaphylla Stevens ined.; 15383B, 16644

ERYTHROXYLACEAE
Erythroxylum ecarinatum Burck; 14763, 14768, 14772, 14786, 14796, 14992, 15039

EUPHORBIACEAE sens. lat. (including Phyllanthaceae)
Actephila lindleyi (Steud.) Airy Shaw; 14386, 14456, 14639, 14677, 15030, 15354, 16592; Jacobs 9538; LAE 52031; NGF 45136
Antidesma moluccanum Airy Shaw var. *moluccanum*; 15417
Antidesma polyanthum K. Sch. & Laut.; 14856, 15014
Antidesma cf. *sarcocarpum* Airy Shaw; 14972; NGF 28061 (K)
Antidesma sphaerocarpum Muell. Arg.; 14474, 14493, 15038, 15414, 15568; LAE 52051; NGF 45167
Aporosa brassii Mansf.; NGF 45133
Aporosa praegrandifolia (S.Moore) Schot; 15168; LAE 52049; NGF 45134, 45171
Breynia cernua (Poir.) Muell. Arg.; 14423, 14580, 14834, 14967; NGF 47782
Claoxylon aff. *ledermannii* Airy Shaw var. *ledermannii*; 14738, 14751 (nos. distr. as

group'*Purpurescentia*'), 15386, 15416, 16587; LAE 51669
Cleistanthus pedicellatus Hook. f.; 14749 (distr. as *Kairothamnus phyllanthoides*)
Cleistanthus sp., cf. *myrianthus* (Hassk.) Kurz; 16621; NGF 44608
Cleistanthus sp., aff. *pedicellatus* Hook. f.; 14473 (leaves obtuse, capsule lobed)
Codiaeum variegatum (L.) Bl. var. *moluccanum* (Decne) Muell. Arg.; Jacobs 9596; NGF 45143
Croton cf. *choristadenius* K. Sch.; 14747, 15151, 16442; NGF 45101, 45102
Endospermum cf. *labios* Schodde; 15255
Euphorbia hirta L.; 14435
Glochidion granulare Airy Shaw; 16412
Glochidion sp.; 14571
Kairothamnus phyllanthoides (A. Shaw) A. Shaw; LAE 52046, 73372; NGF 24462, 44211, 44602, 45108
Macaranga angustifolia Laut. & K. Sch.; 15375; NGF 25674
Macaranga bifoveata J.J. Smith; 14525, 14582, 14586, 14807, 15359, 16431
Macaranga polyadenia Pax & Hoffm.; SR, passim
Macaranga tanarius (L.) Muell. Arg.; NGF 44609 (nv)
Manihot esculenta Crantz; SR, cult. Lababia
Phyllanthus cf. *effusus* S. Moore; 14321, 14387
Phyllanthus sp.; NGF 45177
Pimelodendron amboinicum Hassk.; 14788, 15405; NGF 31640 (K), 31643 (K)
Suregada glomerulata (Bl.) Baill.; 14367, 15013, 15034

FABACEAE

Abrus pulchellus Thwaites ssp. *pulchellus*; NGF 62046
Arachis hypogaea L.; SR, cult. Lababia
Archidendron lucyi F.v.M.; 15436
Archidendron molle (K. Sch.) de Wit, vel aff.; 16524; Jacobs 9621; LAE 52760; NGF 28090 (K)
Archidendron ptenopum Verdc.; 16616; NGF 44212
Archidendron sp.; 15022
Caesalpinia crista L.; NGF 22896
Crotalaria retusa L.; 15376
Dahlbergia candenatensis (Dennst.) Prain; 14882
Derris indica (Lam.) J.J. Bennett; 14619, 15123; NGF 25686 (nv)
Derris trifoliata Lour.; SR, Tabali
Desmodium umbellatum (L.) DC.; 14361, 14450, 15117
Inocarpus cf. *papuanus* Kostermans; 14719
Intsia bijuga (Colebr.) O. Kuntze; SR, Bulili shoreline
Macropsychanthus lauterbachii Harms; SR, Saia River
Maniltoa sp., aff. *schefferi* K. Sch. & Hollrung; 14318, 15582; sp. E in Verdcourt (1979)
Mucuna schlechteri Harms; 14746, 14966, 15377; Jacobs 9640; NGF 25673, 45096
Ormosia calavensis Azaola ex Blanco; 14958
Sophora tomentosa L. ssp. *tomentosa*; Martin 2520; NGF 47774
Vigna unguiculata (L.) Walp.; SR, cult. Lababia

FAGACEAE

Lithocarpus vinkii Soepadmo; 14317, 14517 (nos. distr. as *L. celebicus*); NGF 24492, 31622 (K), 44213

GENTIANACEAE

Fagraea amabilis S. Moore; 14462 (610 m)
Fagraea berteroana A. Gray ex Wall.; Jacobs 9542; LAE 52314 (nv)
Fagraea ceilanica Thunb.; 14369, 14598, 15020
Fagraea racemosa Jack ex Wall.; 14760, 14908, 14979, 15340; Jacobs 9622; LAE 51665, 52041, 52335, 68510; NGF 22885 (K)

GESNERIACEAE

Aeschynanthus cf. *kermesinus* Schltr.; 14504
Aeschynanthus cf. *leptocladus* C.B. Clarke; 14461
Boea lawesii H.O. Forbes; LAE 62047
Boea mollis Schltr.; NGF 47781
Cyrtandra schumanniana Schltr., vel aff.; LAE 51682
Cyrtandra sp., sect. *Centrosiphon*; NGF 45173
Cyrtandra sp., sect. *Loxophyllum/Phaeotrichium*; 14458, 14485

GOODENIACEAE

Scaevola oppositifolia R. Br.; SR, Kulindi
Scaevola sericea Vahl; 14363

ICACINACEAE

Platea latifolia Bl.; 15421
Rhyticaryum longifolium K. Sch. & Laut.; 14653, 14664, 14877; Jacobs 9671

LAMIACEAE

Callicarpa longifolia Lamk.; NGF 22883 (K)
Gmelina ledermanni H.J. Lam; 14365, 14487,

14924, 15026, 15114, 15343; Jacobs 9536; NGF 28077 (K); Rau 609

Leucas flaccida R. Br.; NGF 25684

Plectranthus sp., aff. ?*parviflorus* Willd.; 14437 (does not key)

Premna serratifolia L.; 14441, 14893; NGF 47784

LAURACEAE

Actinodaphne nitida Teschn.; NGF 31637 (K)

Cassytha filiformis L.; 14527, 14540

Cinnamomum eugenoliferum Kosterm.; NGF 45130

Cryptocarya cf. *densiflora* Bl.; LAE 52315

Cryptocarya laevigata Bl.; 14709, 14947, 14953, 15153, 16588, 16608

Cryptocarya multipaniculata Teschn.; 15241

Cryptocarya novoguineensis Teschn.; 16633; NGF 28086 (K)

Cryptocarya pulchella Teschn., vel aff.; 15578

Cryptocarya sp.; 14476

Endiandra engleriana Teschn.; NGF 28068 (K)

Endiandra forbesii Gamble; NGF 39098, 45187

Litsea sp., *collina* facies; 15348

Litsea sp., *guppyi* facies; 14703, 14978, 15244; NGF 24472

Persea americana Mill.; SR, cult. Lababia

LECYTHIDACEAE

Barringtonia apiculata Laut.; 15113; LAE 52053; NGF 28081 (K)

Barringtonia asiatica (L.) Kurz; SR, Lababia, also several colls. Lasanga

Barringtonia lumina Jebb ined.; SR, Saia River (uncommon); NGF 45145

Barringtonia pinifolia Jebb ined.; 14560, 14576, 14681, 14704 (distr. as *B. calyptrocalyx* cf. var. *boridiensis*), 16438, 16585; Jacobs 9550

Barringtonia racemosa (L.) Spreng.; 15250

Barringtonia sp., aff. ?*acutangula* (L.) Gaertn.; 15364

Barringtonia sp. A; NGF 25676, listed as unidentified 'group 2' in Jebb (1991)

Barringtonia sp. B; 14866 (distr. as *B. calyptrata* but not that species)

LINACEAE

Hugonia jenkinsii F.v.M.; 14632, 15112, 15160; Jacobs 9603; NGF 24470

LOGANIACEAE

Geniostoma rupestre J.R. & G. Forst.; 16597; Conn et al. 175, 178, 186, 207; Jacobs 9597, 9613; NGF 24486, 47763; Rau 283, 590, 606, 608, 614, 617

Geniostoma rupestre J.R. & G. Forst. var. *rupestre*; 14448, 14480, 14714, 14727, 14752, 14832, 14838, 14855, 14931, 15072, 15442

Neuburgia corynocarpa (A. Gray) Leenh.; 15245, 15258, 15363

Strychnos minor Dennst.; 14316, 15024, 15027

LORANTHACEAE

Amyema scandens (Tiegh.) Danser ssp. *scandens*; 16432

Decaisnina hollrungii (K. Sch.) Barlow; 14551, 16421; NGF 45196

Dendrophthoe curvata (Bl.) Miq.; 14430, 14529

genus indet.; NGF 47761

MAESACEAE

Maesa haplobotys F.v.M.; 14923, 15238, 15384, 16620

MALVACEAE

Brownlowia argentata Kurz; 15275

Commersonia bartramia (L.) Merr.; 14410, 14460, 14823, 15047, 15342; Swaine 10

Heritiera littoralis Ait.; 15249; LAE 52333

Hibiscus tiliaceus L.; SR, Tabali River and Lababia beachfront

Kleinhovia hospita L.; SR, Lababia

Microcos sp.; NGF 28069 (K)

Sida cordifolia L.; 14434

Sterculia cf. *lepidostellata* Milbr.; 14820

Sterculia morobeensis Tantra; Jacobs 9663; NGF 28093 (K)

Sterculia schumanniana (Laut.) Mildbr.; 14721; Conn et al. 211; LAE 62045; NGF 28076 (K)

Sterculia sp. ?nov., aff. *shillinglawii* F.v.M.; 14591, 14743, 14803, 15181

Sterculia sp. nov., fide Tantra (1976); Jacobs 9639

Thespesia populnea (L.) Sol. ex Correa; SR, Lababia

MELASTOMATACEAE

Astronidium morobiense Maxw.; 15351, 15560, 16223 (dets. S.S. Renner); NGF 25658 (nv) and 45180 (nv) could be this sp.

Medinilla sp., aff. *tenuipedicellata* Bak. f.; 14795

Medinilla spp.; 15365, 16615

Melastoma malabathricum L. ssp. *malabathricum*; 14372, 15121 (distr. as *M. affine* D. Don)

Poikilogyne sp.; NGF 45232

MELIACEAE

Aglaia brownii C.M. Pannell; 14911; NGF 24446
Aglaia cf. *rimosa* (Blanco) Merr.; 14666, 15076
Aglaia sapindina (F.v.M.) Harms; 14427, 15230, 15266, 15366, 15574, 16222; Jacobs 9576, 9607; NGF 45140; Warete-Namorong 7
Aglaia tomentosa Teijsm. & Binn.; 15407, 15422, 16643
Aglaia sp., aff. ?*agglomerata* Merr. & Perry; 14332, 14482, 15179 (distr. as *A. silvestris*, vel aff.), 15419, 15576; NGF 45183
Aglaia sp., aff. ?*sapindina* (F.v.M.) Harms; 14393, 15175, 15191, 15350; LAE 52054
Aphanamixis polystachya (Wall.) R.N. Parker; 15434
Chisocheton lasiocarpus (Miq.) Val.; 15257, 15429
Chisocheton lasiocarpus (Miq.) Val. entity *'schlechteri'*; 15041, 15104, 15161, 15176, 16599; LAE 52343
Chisocheton lasiocarpus (Miq.) Val. entity *'weinlandii'*; LAE 62059
Chisocheton sapindinus Stevens; 14336, 15411, 15574, 16414; NGF 45140
Dysoxylum arborescens (Bl.) Miq.; LAE 51686
Dysoxylum papuanum (Merr. & Perry) Mabb.; LAE 52319
Vavaea amicorum Benth.; NGF 24482
Xylocarpus granatum Koen.; 14634, 14899

MEMECYLACEAE

Memecylon sp., *sepicana-schraderbergense* facies; 14670; NGF 25003

MENISPERMACEAE

Hypserpa polyandra Becc. var. *polyandra*; 14553, 14744, 15078; Jacobs 9653; LAE 51673; NGF 24473
Macrococculus pomiferus Becc.; LAE 62057

MONIMIACEAE

Kairoa suberosa Philipson; 15430
Kibara oblongata Philipson, vel aff.; 14334, 15012
Levieria nitens Perkins; NGF 24439 (nv)
Steganthera hirsuta (Warb.) Perkins; 14575, 14706, 15164; NGF 25687

MORACEAE

Artocarpus communis J.R. & G. Forst.; SR, Tabali River
Ficus adenosperma Miq.; 14359
Ficus ampelas Burm. f.; 14565, 14581, 14592, 14726; NGF 45118
Ficus arfakensis King; 15263
Ficus benjamina L.; LAE 52300, 68522; NGF 44154
Ficus calodictya Summerh.; 14962
Ficus gul Laut. & K. Sch.; 15019, 15222, 15272
Ficus hystricicarpa Warb.; 14687, 14964
Ficus irritans Summerh.; 14691, 14970
Ficus itoana Diels; 14626
Ficus odoardi King; NGF 51671
Ficus pachystemon Warb.; 14491, 14569, 14584, 14673, 14696, 15210, 15401, 15569B (some nos. merging with *F. subtrinervia* Laut. & K. Sch.)
Ficus rhizophoriphylla King; NGF 28087 (K)
Ficus trachypison K. Sch. var. *pallida* Corner; LAE 52759
Ficus wassa Roxb.; NGF 31645 (K)
Parartocarpus venenosus (Zoll. & Mor.) Becc. ssp. *papuanus* (Becc.) Jarrett; NGF 25001 (K)
Prainea papuana Becc.; NGF 45150

MYRISTICACEAE

Gymnacranthera farquhariana (Hook. f. & Th.) Warb. var. *zippeliana* (Miq.) R. Schouten; 14337, 14680, 14872, 14945, 14954A, 15410, 16625, 16626, 16627, 16628
Horsfieldia hellwigii (Warb.) Warb.; 15435
Horsfieldia laevigata (Bl.) Warb. var. *laevigata*; LAE 51683, 52030
Horsfieldia pilifera Markgr.; Jacobs 9609, 9609A; LAE 52756; NGF 28080 (nv)
Horsfieldia sylvestris (Houtt.) Warb.; 15271
Horsfieldia tuberculata (K. Sch.) Warb. var. *tuberculata*; 14549
Myristica chrysophylla Sincl. ssp. *chrysophylla*; 14735, 14951, 15438; Jacobs 9574; LAE 52032, 52062; NGF 45166
Myristica chrysophylla Sincl. cf. ssp. *entrecasteauxensis* (Sincl.) de Wilde; 14335, 14602, 15018, 15082, 15130; LAE 52029
Myristica cornutiflora Sincl. ssp. *elegans* de Wilde; 14590, 14860
Myristica filipes de Wilde; 14566, 14700, 14935; Conn et al. 182, 281 (nv); LAE 51668, 52061 (nv); NGF 45115, 45116
Myristica globosa Warb.; Jacobs 9572
Myristica markgraviana A.C. Smith; LAE 52027
Myristica sulcata Warb.; Jacobs 9685; LAE 52028
Myristica tubiflora Bl.; NGF 45142
Myristica umbrosa Sincl.; 14600, 15188; LAE 52033, 52047, 52287, 52332; NGF 25659

Myristica sp. ?nov.; 14340, 14661, 15011, 15109, 15397, 16424, 16573
Myristica sp.; 16591

MYRSINACEAE

Aegiceras corniculatum (L.) Blanco; 15274
Conandrium polyanthum (Laut. & K. Sch.) Mez; 14338, 14447, 14570, 14761, 14774, 14825; LAE 52040, 52050
Discocalyx kaoyae Pipoly & Takeuchi ined.; 16441
Discocalyx orthoneura K. Sch.; NGF 24451
Discocalyx sp.; Jacobs 9584 (nv)
Fittingia tubiflora Mez; 14425, 14429, 14445, 14572, 14991, 14997, 14999, 16580, 16582, 16596, 16622; LAE 52302
Fittingia urceolata Mez; Conn et al. 284; Jacobs 9644; NGF 45139, 45163; Rau 291
Myrsine leucantha (K. Sch.) Pipoly; NGF 24429, 45235 (nv)
Myrsine rawacensis A. DC.; 14604, 15562; NGF 44603
Myrsine sp., (*Rapanea ?lamii* Sleumer); 14469

MYRTACEAE

Decaspermum bracteatum (Roxb.) A.J. Scott var. *bracteatum*; 14611, 14770, 14782, 14792, 15007, 16567; LAE 52322
Eucalyptopsis papuana C.T. White; LAE 52296, 52331, 52334; NGF 28097 (K)
Lophostemon suaveolens (Sol. ex Gaertn.) P.G. Wilson & J.T. Waterh.; 15116
Myrtella beccarii F.v.M.; 14349, 14380, 14814, 15583; Bellamy 6; Jacobs 9650; LAE 52292, 72469; NGF 44151; Paijmans 1564; Swaine 8; Watt sn
Octamyrtus insignis Diels; NGF 25018
Psidium guajava L.; SR, cult. Lababia
Rhodamnia blairiana F.v.M. var. *propinqua* (C.T. White) A.J. Scott; 14405, 14841; NGF 44215
Rhodomyrtus pinnatinervis C.T. White; LAE 52304 (600 m)
Syzygium buettnerianum (K. Sch.) Niedenzu, vel aff.; Jacobs 9677; LAE 52297
Syzygium claviflorum (Roxb.) Cowan & Cowan; 14477
Syzygium effusum (A. Gray) C. Muell., sens. lat.; 14315; NGF 24483, 45159
Syzygium cf. *flavescens* (Ridley) Merr. & Perry; 14341
Syzygium furfuraceum Merr. & Perry; 14740, 14944; NGF 31635 (K), 31650 (K)
Syzygium leptoneurum Diels; 15194; NGF 39095, 47770; Swaine 9
Syzygium longipes Merr. & Perry; 14388
Syzygium nutans (K. Sch.) Merr. & Perry; Jacobs 9629; NGF 24459
Syzygium richardsonianum Merr. & Perry, vel aff.; 14733, 14954B, 15084, 15144, 15399; LAE 51663; NGF 24476, 39431
Syzygium subcorymbosum Merr. & Perry; LAE 52289, 52317; NGF 45106
Syzygium thornei Hartley & Perry; NGF 24428
Syzygium trivene (Ridley) Merr. & Perry; 14381, 14402, 14413, 14484, 14518, 14588, 14618, 14688, 14737, 14851, 14969, 14994, 14998, 15396, 15437, 15569A, 16434, 16581; Jacobs 9617, 9645; LAE 51664; NGF 24497, 25657, 39419, 44155
Syzygium cf. *trivene* (Ridley) Merr. & Perry; 14773, 14811, 14835, 14845; NGF 25669 (nonconformist nos. with persisting bracts but cf. Hartley & Perry 1973: 213)
Syzygium viburnoides Diels; 14479
Syzygium xylopiaceum (Diels) Merr. &.Perry; Jacobs 9654; LAE 52291
Syzygium sp., =*Acmena acuminatissima* (Bl.) Merr. & Perry; NGF 28095 (K)
Syzygium sp., aff. *malaccense* (L.) Merr. & Perry; 15349
Syzygium sp., aff. ?*rostratum* (Bl.) DC.; 15127
Syzygium sp. ?nov.; aff. *pyriforme* Merr. & Perry; 15382, 16607
Syzygium sp. ?nov., aff. couplet 57a or 88a; 14723, 14724, 14725
Syzygium sp.; 15095
Syzygium sp.; 15428
Tristaniopsis macrosperma (F.v.M.) P.G. Wilson & J.T. Waterh.; 14343, 15058, 15131, 15579; NGF 24464, 44607; Vinas & Kairo 295
Tristaniopsis oreophila (Diels) P.G. Wilson & J.T. Waterh.; NGF 42638
Xanthostemon petiolatus (Val.) P.G. Wilson; 15147, 15345

NEPENTHACEAE

Nepenthes neoguineensis Macf.; 14453, 14697; 14837 (distr. as *N. mirabilis*), 15573, 16435; Jacobs 9651, 9658; LAE 52313; NGF 24461, 24463; Rau 571; Watt 31

NYCTAGINACEAE

Pisonia longirostris Teijsm. & Binn.; LAE 62049

NYSSACEAE

Mastixia kaniensis Melch. ssp. *kaniensis*; LAE 52339

OCHNACEAE

Brackenridgea forbesii Tieg.; 16629; NGF 25004 (K), 28091 (K), 44205

Schuurmansia henningsii K. Sch.; 15220; NGF 31620 (K), 39413, 39430

OLACACEAE

Anacolosa papuana Schellenb.; 16624

OLEACEAE

Chionanthus ramiflorus Roxb.; LAE 62048

Chionanthus rupicolus (Lingelsch.) Kiew; 14385, 14607, 14672, 14883, 15149 (distr. as *C. ramiflorus*); Bellamy 9; LAE 52325; NGF 24465; Rau 572

Chionanthus sessiliflorum (Hemsl.) Kiew; LAE 62060

Jasminum schumannii Lingelsh.; LAE 62050

OXALIDACEAE

Averrhoa bilimbi L.; 14408, 14817

PANDACEAE

Galearia celebica Koord. var. *celebica*; 14660, 14927, 15037, 15209, 15400, 15403; LAE 51672

PASSIFLORACEAE

Adenia heterophylla (Bl.) Koord. ssp. *heterophylla*; NGF 62062

Passiflora foetida L.; SR, Lababia

PENTAPHYLACACEAE

Eurya sp./?spp.; 14463; NGF 24431 (nv), 45234 (nv)

PIPERACEAE

Piper aduncum L.; 15273

Piper celtidiforme Opiz.; 15243

Piper lessertianum (Miq.) C. DC.; 14432, 14455, 14828

Piper macropiper Pennant; 14561

Piper novoguineense Warb.; 14345

Piper pseudoamboinense C. DC.; NGF 25678

Piper versteegii C. DC.; LAE 51689

Piper sp.; 14314

POLYGALACEAE

Eriandra fragrans Royen & Steen.; 14376, 14683, 14777, 14871, 14873, 14874, 14875, 14946, 15239, 15380

Polygala paniculata L.; 14375

POLYOSMACEAE

Polyosma sp., aff. *forbesii* Val.; 14329, 14466, 14884, 14894, 15090, 15413; NGF 52337

PROTEACEAE

Bleasdalea papuana (Diels) Domin; LAE 52344 (550 m)

Finschia chloroxantha Diels; 14364, 15146; LAE 52060, 52345; NGF 45119, 47783

Grevillea papuana Diels; 14449, 14521

Helicia obtusata Sleum.; LAE 51685, 52038, 52288, 52298

Stenocarpus moorei F.v.M.; 14526, 14534, 14984, 14989, 15394, 16426; LAE 52044, 52294, 52326; NGF 39091

RHAMNACEAE

Alphitonia excelsa (Fenzl) Reiss. ex Endl. (sensu Schirarend); 15335, 15374; Jacobs 9667

Alphitonia macrocarpa Mansf.; 15408; NGF 25664

RHIZOPHORACEAE

Bruguiera gymnorrhiza (L.) Lamk; 14377

Ceriops tagal (Perr.) C.B. Rob.; 15148B; Bellamy 16; LAE 68539

Gynotroches axillaris Bl.; 15091, 15570; Jacobs 9684; NGF 24494, 31641 (K)

Rhizophora apiculata Bl.; LAE 68537, 68543

Rhizophora stylosa Griff.; 15143

ROSACEAE

Rubus fraxinifolius Poiret; LAE 62052

RUBIACEAE

Anthorrhiza echinella Huxley & Jebb; 14470 (distr. as *Myrmecodia tuberosa*); NGF 39094, 45103

Atractocarpus macarthurii (F.v.M.) Puttock; Jacobs 9580

Atractocarpus sp., =*Randia sphaerocarpa* K. Sch. & Laut.; NGF 24454

Atractocarpus sp.; 14342, 14370, 14472, 14676, 14707, 14711, 14928, 15081, 15369, 15370; NGF 25009 (K), 39093, 45152, 47777

Canthium sp., sens. lat.; 14654, 15100, 15136, 15237; Heads 268; NGF 39429, 45158, 47760, 47772; Rau 287

Gardenia lamingtonii F.M. Bailey; NGF 45185

Gardenia sp. nov.; 14864, 15101, 15558, 15575; NGF 25675, 45156

Gynochthodes aff. *verticillata* (Val.) Hosokawa; 14692, distr. as *'Randia'*

Hedyotis corymbosa (L.) Lam.; 14541

Hedyotis pubescens Val.; NGF 45176

Hydnophytum hellwigii Warb.; 15207; NGF 25662, 45105
Hydnophytum cf. *radicans* Becc.; LAE 62058
Hydnophytum sp. A; 14399
Hydnophytum sp. B; 14949; Jacobs 9669
Ixora sp. A; 14322, 14371, 14392, 14625, 14628, 14854, 14887, 14926, 14936, 14938, 14976, 15000, 15003, 15119, 15341; LAE 51675, 52042, 62061; NGF 24495, 31630 (K), 45179
Ixora sp. B; 14481, 15009, 15105, 15385, 15581, 16420, 16609
Lasianthus sp., *papuanus-chlorocarpus* facies; 15178, 15197
Morinda citrifolia L.; 14424, 15368; Conn 320; Jacobs 9702; LAE 52293; NGF 47769
Morinda umbellata L.; 14478, 14635
Mussaenda ferruginea K. Sch.; 14757
Myrmecodia tuberosa Jack; 14730
Nauclea orientalis (L.) L.; 15254
Nauclea tenuiflora (Havil.) Merr.; NGF 22886 (K)
Neonauclea clemensii Merr. & Perry; NGF 22489
?*Porterandia*, =*Randia ixoraeflora* Wernh.; Jacobs 9689; NGF 51688, 52057
Psychotria amplithyrsa Val.; 15166; NGF 51680
Psychotria archboldii Sohmer var. *archboldii*; 14904, 14906, 15028, 16415, 16422
Psychotria bulilimontis var. *aestuarii* Takeuchi; 14990, 14993, 14995, 15002
Psychotria bulilimontis Takeuchi var. *bulilimontis*; 16416, 16428
Psychotria croftiana Sohmer; 14490, 15048, 15139, 15566, 16430B, 16578; Jacobs 9636
Psychotria diplococca Laut. & K. Sch. var. *diplococca*; 15432
Psychotria cf. *leiophloea* Merr. & Perry; 15234, 15236, 16430A
Psychotria leonardii Merr. & Perry; 15057
Psychotria leptothyrsa Miq. var. *leptothyrsa*; 14492; Jacobs 9567
Psychotria membranifolia Bartl. ex DC.; 14488, 14750, 14831, 15184, 15203, 16575, 16577, 16606
Psychotria micralabastra (Laut. & K. Sch.) Val.; 15068, 15339, 15426, 15427; NGF 31651 (K)
Psychotria micrococca (Laut. & K. Sch.) Val.; Conn et al. 278 (nv)
Psychotria olivacea Val.; 14771, 14827, 14898, 14900, 15108, 15189, 15357, 16437; Jacobs 9638; NGF 28083 (K)
Psychotria waiuensis Sohmer; 14310; NGF 25626
Psychotria sp. ?nov.; 15170, 15174A, 16593; Vinas & Kairo 304
Psychotria sp. (liane); LAE 62053
Psydrax sp., =*Canthium cymigerum* (Val.) B.L. Burtt; 14382, 14784, 14810; NGF 24475, 25667
Scyphiphora hydrophyllacea Gaertn.; 14636; NGF 45112
Timonius paiawensis S. Darwin; 14362, 14440, 14520, 14522, 15065, 15338; Conn et al. 301, 313; LAE 52328; NGF 39097, 47767
Timonius timon (Spreng.) Merr. var. *buloloensis* S. Darwin; 14362B; Jacobs 9626; NGF 44207
Timonius timon (Spreng.) Merr. var. *timon*; 15367
Timonius sp., aff. *rufescens* (Miq.) Boerl.; 14798, 14870
Timonius sp. ?nov.; 14328, 14663, 14781, 15106, 15567
Uncaria lanosa Wall. var. *appendiculata* (Benth.) Ridsd.; 14767
Urophyllum glaucescens Val., vel aff.; 14401, 14891, 15089; Jacobs 9565, 9692; LAE 52056, 52299, 52338; NGF 24448, 28094 (K), 31621 (K), 31626 (K), 45132; Rau 607, 612
Xanthophytum papuanum Wernh.; 14454, 16418; NGF 44210, 45184

RUTACEAE

Acronychia trifoliolata Zoll. & Mor.; 14901, 15118, 15148, 16419
Flindersia laevicarpa White & Francis var. *heterophylla* (Merr. & Perry) Hartley; 14519, 15124, 15132; NGF 31636
Halfordia drupifera F.v.M.; 14344
Melicope denhamii (Seem.) Hartley; 14420, 14523, 14736, 15031
Melicope xanthoxyloides (F.v.M.) Hartley; 15373
Zanthoxylum novoguineense Hartley; 14699, 14759, 14785, 14801, 14813 (distr. as *Euodia* aff. '*alata-mollis* group') 16645; LAE 52311, 52329; NGF 25690
genus indet.; 15564

SABIACEAE

Sabia pauciflora Bl.; 15431

SALICACEAE

Casearia erythrocarpa Sleumer, vel aff.; 14327, 14339, 14368, 14451, 14701, 14806, 14846, 14861, 14909, 14988, 15355; NGF 25671, 28082 (K)
Casearia cf. *macrantha* Gilg; 14848, 14916, 14939, 15162; NGF 52045

Casearia sp., aff. *flexicaulis* K. Sch.; 14357, 14545, 14605, 14616, 14829, 14959, 15115 (14357, 14616, 14829 distr. as *Glochidion* sp.); LAE 51681; NGF 25661
Casearia sp., closest to ?*novoguineensis* Val.; 15418, 16605
Homalium d'entrecasteauxense Craven; 14650, 14876
Scolopia novoguineensis Warb.; 14612, 14627
Trichadenia sasae Takeuchi; 15589, 16561

SANTALACEAE
Exocarpos latifolius R.Brown; 14889, 15120, 15372, 16423; LAE 51666; NGF 39418
Scleropyrum aurantiacum (Laut. & K. Sch.) Pilger; 15198; NGF 31629 (K), 45131, 45174

SAPINDACEAE
Alectryon ferrugineus (Bl.) Radlk.; 14728, 14802, 15247
Arytera cf. *litoralis* Bl.; 14925
Cnesmocarpon discoloroides Adema; 15092; NGF 25007
Dictyoneura obtusa Bl. ('Morobe race' oblique leaflets); 15362, 16427
Euphorianthus euneurus (Miq.) Leenh.; LAE 52318
Guioa grandifoliola Welzen; 14980; Conn et al. 195, 319 (nv); NGF 45154
Guioa rigidiuscula Radlk., or '*rigidiuscula* complex'; 15208, 16614
Harpullia longipetala Leenh.; 15165; NGF 25679
Harpullia ramiflora Radlk.; LAE 62055 (nv)
Mischocarpus pyriformis (F.v.M.) Radlk. ssp. *papuanus* (Radlk.) Ham; NGF 47775
Pometia pinnata J.R. & G. Forst.; NGF 31639
Sarcopteryx squamosa (Roxb.) Radlk.; NGF 44208, 45099
?*Synima* aff. *cordierorum* (F.v.M.) Radlk.; 14550, 14577, 14633
genus indet.; NGF 45216 (nv; listed as *Elattostachys* in LAE logbook)

SAPOTACEAE
Magodendron mennyae Vink; 16570; Conn et al. 194; Jacobs 9537; NGF 24436, 45146
Palaquium cf. *warburgianum* Schltr.; 15085
Pichonia sp., ?*lauterbachiana* (H.J. Lam) Pennington; 14558, 14568, 14793, 14982, 14986 (nos. distr. as *Pouteria sarcospermoides* H.J. Lam); LAE 51674; NGF 39435, 44605, 45107
Pouteria ledermannii (K. Krause) Baehni; 14471, 15088 (dets. W. Vink)
Pouteria luzoniensis (Merr.) Baehni; 14355
Pouteria maclayana (F.v.M.) Baehni; Jacobs 9573
Pouteria obovoidea H.J. Lam; NGF 24496
genus indet.; NGF 45188

SIMAROUBACEAE
Quassia indica (Gaertn.) Nooteboom; 14389

SOLANACEAE
Capsicum anuum L.; SR, cult. Lababia
Solanum anfractum Symon; Jacobs 9558; NGF 24441
Solanum melongena L.; SR, cult. Lababia
Solanum symonianum Takeuchi; 12027

STEMONURACEAE
Gomphandra ?*pseudoprasina* Sleum.; LAE 62056 (nv)
Stemonurus ammui (Kaneh.) Sleum.; 14400, 14756, 14857, 14983; NGF 24481 (nv)

SYMPLOCACEAE
Symplocos cochinchinensis (Lour.) S. Moore; 14464, 15008, 15152

THEACEAE
Gordonia papuana Kobuski; 15093, 16576; NGF 31625 (K)

THYMELAEACEAE
Phaleria coccinea (Gaud.) F.v.M.; 14745, 15017, 15193, 15218, 15565; NGF 28062 (K)
Phaleria macrocarpa (Scheff.) Boerl.; 16601

URTICACEAE
Dendrocnide longifolia (Hemsl.) Chew; 15260
Poikilospermum sp.; 14934

VERBENACEAE
Stachytarpheta cayennensis (Rich.) M.Vahl; 14537

VITACEAE
Cissus sp., '*javana-discolor* group'; Jacobs 9592
Tetrastigma sp.; NGF 28074 (K; Leiden det. ticket gives *T. pedunculare*)

WINTERACEAE
Zygogynum sp.; 14465

FAMILY INDET.; 14373, 14374, 14675

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